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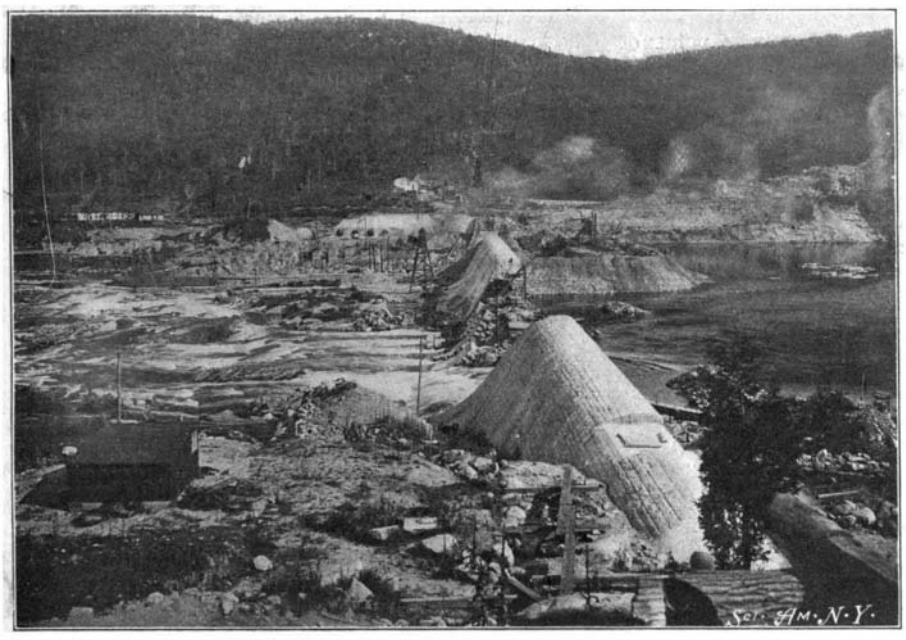
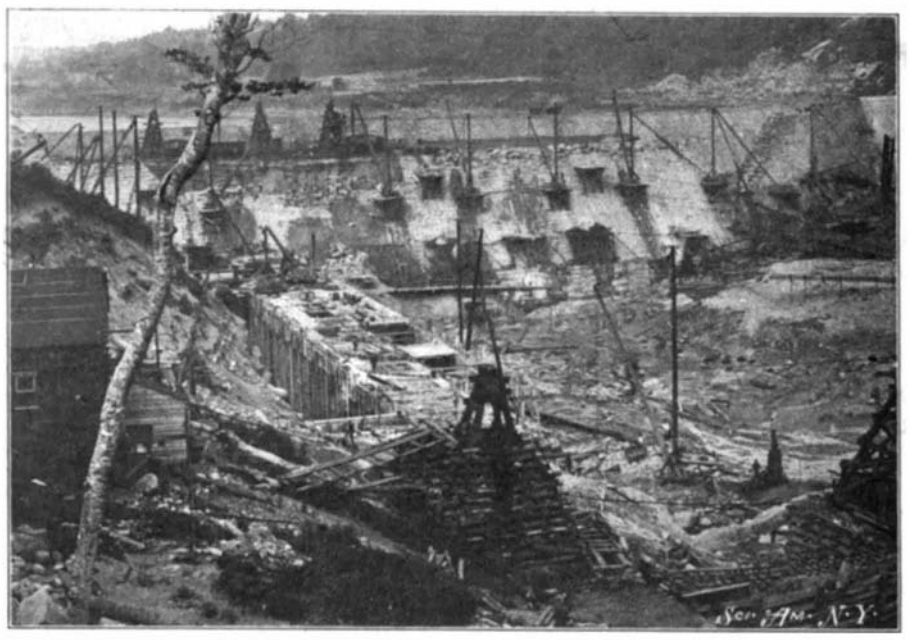
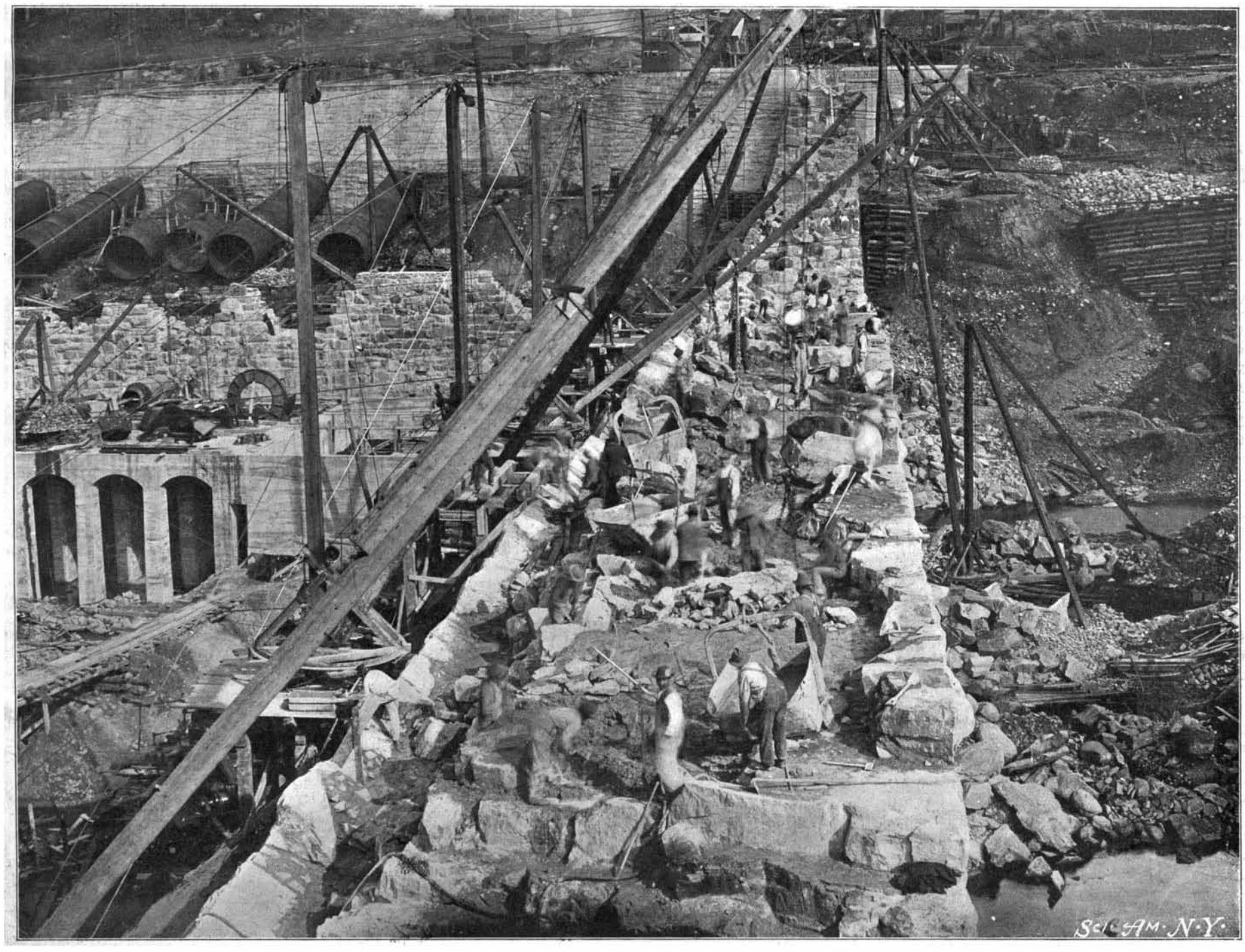


Showing Down-Stream Face of Partially Completed Dam.



View from Below Dam, Power House in Foreground.



View Showing the Main Dam, the 12-Foot Penstocks, the Floor and Tailrace of the Power House.

THE 50,000 HORSEPOWER POWER HOUSE AT SPIER FALLS.—[See page 186.]

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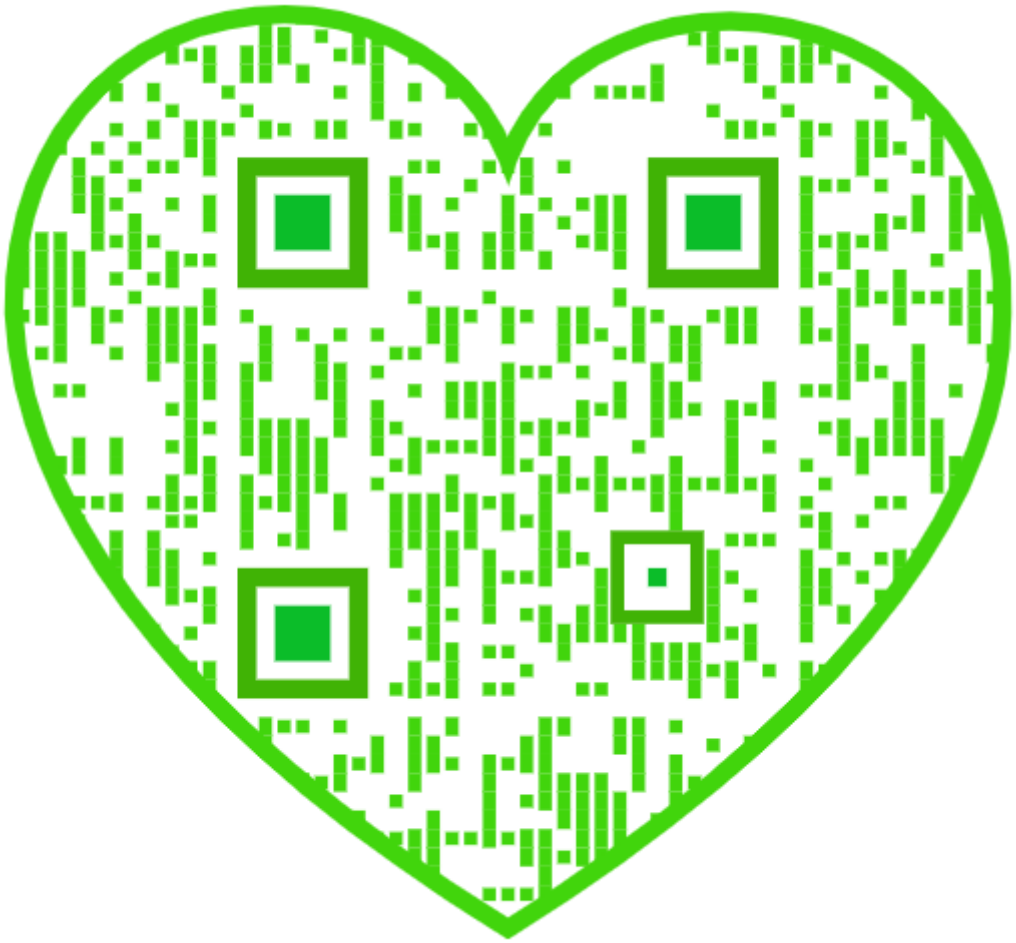

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NEW YORK, SATURDAY, SEPTEMBER 12, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

ANOTHER GREAT HYDRAULIC-ELECTRIC POWER PLANT.

No stronger evidence could be afforded of the great development which has taken place in the last few years of hydro-electric installations than the fact that a great 50,000-horse-power plant, such as is illustrated on the front page of this issue, should have been planned and built with such little ostentation that it has only recently, as it neared completion, attracted the attention which its size and importance demands. It seems but a few years ago that the world was filled with wonderment at the announcement that sufficient water was to be diverted from the Niagara River, to operate a series of large turbines, whose aggregate power should reach the then enormous figure of 50,000 horse power. The project was regarded with much curiosity, and there was no little foretelling of disastrous failure, while the day of its opening was regarded as one of the most momentous in the history of the industrial world. This event occurred less than a decade ago; yet, so great was the success of the venture, that its capacity has already been doubled, and another one of far greater size is under construction on the opposite shores of the river. So many similar installations of large aggregate horse power are either planned or under actual construction that the building of a 50,000-horse-power power house, like this one in the upper valley of the Hudson, seems to call for little more than a passing remark. The indications are that within a few generations there will not be a natural waterfall or rapids, except in the unsettled portions of the country, that will not resound with the hum of the turbine and the generator.

THE LAST OF A FAMOUS LINER.

Every one that is interested in the history of the transatlantic service (and who is not?) will learn with a measure of regret that the famous White Star liner "Britannic" is now engaged upon her last voyage, preparatory to being sent to the bone-yard to be broken up. This historic vessel will long be remembered as having ushered in the era of the high-speed, luxuriously furnished transatlantic liner with which we are familiar to-day; for the very latest vessels are merely a development in size, speed, and comfort of certain features which were first embodied in this ship. She is further remarkable because of the unusual endurance of her engines and boilers, which present an instance of continuous service that, as far as we know, is without a parallel in the history of the mercantile marine. It is not generally known that the engines and boilers with which she is now making her last voyage across the Atlantic are the same that were put into the boat by the Harland & Wolf firm when she was launched in 1874, or nearly thirty years ago.

To the "Britannic" belongs the credit of being the first boat to reduce the time between Queeenstown and Sandy Hook to less than eight days, her record for the easterly passage being seven days and sixteen hours. The "Germanic," a sister ship to "Britannic," which was launched shortly after her, is still in the Atlantic service; but she has been re-engined and re-boilered, and thoroughly brought up to date. The older boat, however, has been steadily breasting the storm and stress of the transatlantic passage for twenty-nine years with her original engines and boilers, and she has the remarkable record of never having missed a day in all that time through accident or breakdown. She has remained continually at work except for two or three weeks in each year, when she was taken off the route and overhauled for the season's work. In the twenty-five years from 1874 to 1899 she made 260 round trips between New York and Liverpool, crossing the Atlantic more than 500 times and traveling over 1,800,000 miles, or sufficient to make the circuit of the earth over seventy times. During her long period of service she has carried without accident over 200,000 passengers.

IS YACHT DESIGNING AN EXACT SCIENCE?

The present series of international races has been full of surprises and to no one more than to the two eminent designers of the competing yachts. For it is certain that saving and except for the fact that "Reliance" has done what she was designed to do in successfully defending the cup, each of the great 90-foot sloops has shown, in actual sailing, qualities that were never intended nor expected, and has conspicuously failed to develop other qualities that were specially aimed at in their design. "Reliance," as we announced several months ago when that boat was undergoing her early trials, was designed to secure exceptional speed when reaching, and, indeed, on any point of sailing with started sheets. This quality was expected to make her perfectly sure of winning the triangular race; and in view of the fact that the leeward leg of the windward and leeward races off Sandy Hook is almost invariably turned by a shift of the wind into a reach, it was calculated that being fast under spinnaker and exceptionally fast on a reach, she would be certain to gain on the leeward leg everything that she might lose by her less speedy performance when beating out to the weather mark. It was estimated that, with her great overhang and full waterlines, the most unfavorable conditions for "Reliance" would occur when sheets were hard aboard, and she was heading into a short and broken sea. As a matter of fact this estimate of the boat turned out to be entirely at fault; for she was unable to beat "Constitution" on a reach, while in windward work she proved to be a most consistent and remarkable performer. Even in the much-dreaded combination of light winds and lumpy seas, she has proved to be a simply phenomenal craft, being, indeed, so swift under these conditions as to stand in a class absolutely by herself. Thus has theory proved itself to be once more entirely at sea, and on no point so much as on the failure of "Reliance" to develop any remarkable speed when reaching in a whole-sail breeze. Anyone looking at her lines would expect that the easy diagonals, the great length of her water line, and the small displacement in proportion to the enormous rig, would enable her to reel off a speed of at least 13½ to 14 knots an hour. Yet, as a matter of fact her highest recorded speed in reaching on a measured 10-mile leg is only 12.6 knots per hour. How this discrepancy is to be explained, nobody, not even Mr. Herreshoff himself, can tell.

Turning now to the challenger, it was evident to every one who is acquainted with the elementary principles of yacht designing that her best work should be done in light winds, when the relatively small area of wetted surface which always goes with a full model of large displacement, such as she shows, would tell in her favor. The boat was evidently built for the Sandy Hook courses where light and moderate winds prevail at the time of the year when the races take place. It was natural to expect that in the stronger winds, when the speed passed the point at which the fuller body and relatively larger displacement of the English boat would tend to set up wave-making, the chances of "Shamrock" holding "Reliance" would diminish, and that the stronger the wind, the less would be her liklihood of taking the race. Here again theory has been totally upset, for in the contests that have been held the "Shamrock" has shown to the best advantage when the winds were strongest, and as the strength of the wind diminished, so the margin by which she has been beaten has steadily increased. In the triangular race sailed in a good breeze of 10 to 15 knots strength, when, theoretically, "Reliance" should have dropped her steadily with every mile that was sailed, particularly on the 20 miles of reaching, she proved so far the equal of our boat that, on corrected time, if we omit the 19 seconds handicap at the start, she was only beaten by one minute. On the other hand, in an attempted race in which there was that very roll of the sea and light wind which was supposed to embody the ideal conditions for "Shamrock," she was beaten by the same boat 20 minutes in a 15-mile leg to windward.

It is because of these strange anomalies that the yachting world is drawing on its thinking cap, in the endeavor to find just exactly where it stands; for there is no denying that these two boats, in which are embodied the wisdom and skill of the two leading naval architects of the day, have persistently done the things that nautically they ought not to have done, and have left undone the things that nautically they should have done!

The moral of all this is that in spite of our boasted advancement in the art of yacht design we have as yet by no means reached the ideal boat; and we shall not have done so until some one discovers how to combine with the remarkable beating and running qualities of "Reliance," the ability to reel off 13 to 14 knots an hour when reaching in a whole-sail breeze.

LIMITS OF ELECTRIC TRACTION WITH DIRECT CURRENT.

Systems of electric traction differ widely as to the power that may be delivered to a car, the distance from a generating station at which a car may be operated, and the rate of acceleration that a car may attain. With continuous-current dynamos supplying car motors at pressures of about 500 volts, a limit to the power that may be delivered through a single trolley contact is soon reached.

A car with a motor equipment of 200 horse power, such as is not uncommon for interurban service, draws 350 amperes from the trolley wire when loaded to full rated capacity, if the motors have an efficiency of about 85 per cent and their voltage is 500. At starting and on heavy grades the amperes taken by such a car may go up to 1,000 without serious heating at the trolley, but it is doubtful whether this current could be collected constantly without trouble. Coming to a large electric locomotive or heavy train requiring 2,000 horse power at normal rating, the regular current with voltage and motor efficiency as before, would be 3,500 amperes, which might rise to 10,000 or 15,000 amperes for short periods. Such currents are entirely beyond the capacity of any single trolley or contact shoe. A number of trolleys might be employed with a heavy train or locomotive, but such complication would soon reach a limit. The limitations as to radius of operation of the 500-volt continuous-current traction system may be well illustrated by an example. If a car requiring 200 brake horse power on the wheels, or a delivery of 350 amperes and 500 volts at its motors, is operated ten miles from the station with a drop of 50 volts in its feeder wire, this wire must have an area of 400,000 circular mils. Ten miles of such wire with weatherproof insulation weigh 80,000 pounds, and at 15 cents per pound have a value of $12,000. This sum represents an investment of $60 per horse power capacity of the feeder wire, or about three times the cost of dynamos per like unit of capacity. Assuming that only 50 volts drop will occur in the rails as a return circuit when the drop in the trolley feeder is 50 volts, the total loss of pressure between dynamo and car motors is 100 volts, so that the dynamo must deliver current at 600 volts in the assumed case. This drop of 100 volts on the line and rails corresponds to a loss of 16.66 per cent. For exceptional loads, as when the car is climbing a steep grade, the percentage of loss in feeder wire and rails will increase directly with the amperes flowing to the car. Thus, when the car motors take 1,050 amperes, the fall of pressure in the rails and feeder together will be 300 volts, and one half of the energy delivered at 600 volts by the dynamo will be lost in the transmission. If more than one car is supplied by this feeder, the percentage of loss in it will increase directly with the number of the cars. The torque exerted by the car motors increases approximately with the amperes they receive, but their speed drops with the terminal voltage; hence, though the motors carry a heavy overload, the cars cannot maintain normal speed because of the loss of pressure in line and rails.

When under normal full load, the car in question receives 350 amperes at 500 volts, or 175 kilowatts. When an overload causes the current to rise to 1,050 amperes, the pressure at the motors drops to 300 volts and they receive 315 kilowatts, or 1.8 times the power delivered to them at normal full load. As the generating station was assumed to operate continuously at 600 volts, it appears that when the output from this station is multiplied by three, the rate of energy delivery to motors increases only 80 per cent. In other words, the proportion of the entire energy output absorbed by the line and track rises with the ampere flow, and an absolute limit is thus put on the power that may be delivered to the car motors. As one-half of the energy sent out by the power station is lost in the line and rails with a current of 1,050 amperes, any further increase of current will actually decrease the power delivered to the car motors, though it will increase their torque. Thus if the station delivers 1,400 amperes at 600 volts to the particular feeder and track under consideration, the motors on the car will receive this current at 200 volts, representing only 280 kilowatts.

In the matter of motor torque, the continuous-current system of electric traction presents its strongest point. The unequalled capacity for increase of torque possessed by the series-wound continuous-current motors has carried street cars up all sorts of grades with all sorts of loads and placed electric traction in the secure position which it occupies to-day. Furthermore, this capacity for increase of torque makes it possible with the continuous-current motor to obtain rates of car acceleration that can be equaled with no other machine of the same normal rating.

The torque of a continuous-current motor depends on the strength of the magnetic field in its air gaps and on the amperes flowing through its armature coils. If the magnetic field remains constant, the armature torque increases directly with its current, and if the field strength goes up also, the torque increases faster

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than the current. But the armature current distorts the magnetic field in the air gap and tends to cause destructive sparking at the commutator, this tendency being greater the larger the current in the armature coils. Where great increase of torque over the normal rating must be had, the continuous-current series motor offers this unique property, that the increase of current which gives the armature greater torque further strengthens this torque by adding to magnetic density in the air gap, and this addition reduces cross magnetization and the tendency to destructive sparking at the brushes. A. D. A.

THE AGREEMENT BETWEEN THE BRITISH GOVERNMENT AND THE CUNARD AND MORGAN COMBINE MERCANTILE FLEETS.

BY OUR LONDON CORRESPONDENT.

The British government has published the terms of its agreements arranged respectively with the Cunard Steamship Company and the Morgan Combine concerning the British vessels which were incorporated in the trust. The government comprises the three branches—the Admiralty, the Board of Trade, and the Postal Department. With regard to the Cunard Company, the government assumes practical control. The financial assistance comprises a loan of $13,000,000 or less under certain circumstances, at a yearly interest of 2¾ per cent, an annual payment of $450,000, and the increase of the postal subsidy from $310,000 to $340,000 a year. The Cunard Company, on the other hand, in answer to this assistance, will build two new vessels of from 24 to 26 knots hourly speed, suitable for use as armed cruisers, and will place the entire Cunard fleet at the disposal of the government whenever required; will improve the mail service, and will guarantee that the company remain purely British both concerning its control and the shareholders. That is to say, no one but a British subject may be an official or have any share interest in the concern. The agreement is to remain in vogue for twenty years from the time the second new vessel departs on her maiden voyage.

Many important clauses are inserted in the agreement, to enable the government to control both the company and its vessels. The most important of these are broadly as follows:

The plans and specifications of the new vessels to be approved by the British Admiralty, who may make reasonable modifications in the designs to suit their especial requirements.

The ships are to be held at the disposal of the government for either purchase or hire. The purchase price is to be the market value of the vessel plus a 10 per cent bonus as compensation for loss or compulsory sale. Depreciation is to be set down at 6 per cent per annum upon the actual cost price of the steamship.

The payment for the hire of a vessel is to vary with its speed. In war time the Admiralty will provide the crew, but when the vessels are requisitioned for naval purposes during peace time the government is to have the option of the crews and will pay them for their services. The rate of payment will vary from $6.25 without crew and $7.50 with crew, for vessels of above 22 knots speed to $4.37 without crew and $5 with crew for vessels of between 14 and 17 knots speed, these rates being per ton per month. The company, on their part, are not to increase unduly freight or other charges and must not give undue preference against British subjects.

The company must not sell or dispose of any vessel of over 17 knots speed, without the sanction of the government. All the ships' officers, except the engineers, are to belong to either the naval reserve or the naval fleet reserve, and not less than one-half of the crew must belong to either of these two branches of the service. In the event of the new vessels failing to attain the minimum guaranteed sea speed of 24½ knots in moderate weather, but not falling below the minimum of 23½ knots, then the amount of the annual subsidy is to be decided by arbitration.

With regard to the mail service, the subsidy for which has been augmented to $340,000 per annum, the service is to be accelerated and improved, and the new vessels are to be included. This payment is also to cover the transit of parcel mails up to a limit of 100 tons' measurement in either direction per week. Any failure in the mail service will result in the infliction of fines and penalties.

The government's control also comprises two nominees, who have the power to give votes equivalent to one-quarter of the number of votes possessed by the company's shareholders. In more explicit words the government holds one-quarter of the concern. Any person other than a British subject who acquires a share is to be forced to dispose of it within three days, failing which the share will be compulsorily sold at the market value to a British subject.

The amount of the subsidy to be paid every year has been deduced by careful investigation. The committee appointed by the Parliament for this inquiry reported that a sum of $552,500 would be necessary to indemnify a company for the financial loss they would sustain by running a 24-knot vessel in time of peace, which sum would have to be increased to $745,000 for a 25-knot boat. On this basis the increase between these two figures would amount to $1,297,500 for two vessels each of 24½ knots. This payment, however, has been compromised by reducing the rate of interest upon the loan of $13,000,000 from the normal outside market rate of 5 per cent to 2¾ per cent.

In the case of the Morgan combine, the agreement is also extended over a period of twenty years, but the government stipulates that in any postal, military, or naval services wherein it may require the utility of the vessels of any of the British steamship companies merged into the combine, they are to be treated precisely the same as other British shipping concerns. One exception, however, is made, and that is the construction of ships of "uncommercial speed" which the government may specially require to be constructed and which are principally intended for war purposes.

The combine undertakes that a majority of the directors of the British companies shall be British subjects; no vessel is to be transferred to a foreign registry without the consent of the British Board of Trade; the ships are to carry the same quota of officers and crew of British subjects as the government stipulates upon other British vessels engaged in the same trade; the government is to have the option of purchasing or hiring any vessel on arranged terms; and one-half of the tonnage at least added to the combine in successive triennial periods from September, 1902, when the agreement was signed, is to be British. With respect to the last clause, reservation is made concerning the ships of "uncommercial speed" and vessels purchased from other than British or American sources which have been running for not less than two years. In the case of any dispute arising between the two parties, the matter is to be referred to the British Lord Chancellor, who is to be the arbitrator, and whose decision either concerning law or fact is to be regarded as final.

From these two agreements it will be recognized that the British government has concluded a fairly powerful bargain, and while it practically acquires the Cunard Company, no antagonism is displayed to the mercantile combine.

MORE INFORMATION ABOUT THE PRIZE FOR A DUST-ARRESTING RESPIRATOR.

The council of the Society of Arts are prepared to award, under the terms of the Benjamin Shaw Trust, a prize of a gold medal, or twenty pounds, for the best dust-arresting respirator for use in dusty processes, and in dangerous trades.

The council are well aware that for many years past the necessity for such an apparatus has been recognized. As far back as 1822 the society awarded its gold medal to Mr. J. H. Abraham, of Sheffield, for a magnetic guard to protect persons employed in dry grinding. The apparatus described in the society's "Transactions" (vol. xl., 1822, p. 135) includes a respirator to cover the mouth and nose. This respirator was fitted with magnets, for the purpose of arresting the fine particles of steel thrown off in the process of pointing needles, and in other processes of dry grinding. Although the invention was greatly appreciated at the time, it appears never to have come into practical use, the main objection to it having been, it is believed, raised by the workpeople themselves, who feared that the lessened risk attached to their employment would lower their wages. Similar considerations have, it appears, stood in the way of the introduction of various appliances intended to limit the risks associated with all trades in which the workpeople breathe a dusty atmosphere. The council, however, think that such considerations are likely to have less weight at the present time, and they hope that the offer of a prize may draw the attention of inventors to the matter, so that it may result in the production of some suitable piece of apparatus, despite the difficulties with which the solution of the problem is surrounded.

The apparatus will be required to fulfill the following conditions:

(1) It must be light and simple in construction.

(2) It should be inexpensive, so as to admit of frequent renewal of the filtering medium or of the respirator as a whole; or alternatively it should be of such construction that it can be readily cleaned.

(3) It should allow no air to enter by the nostrils or mouth except through the filtering medium.

(4) It should not permit expired air to be rebreathed.

(5) The filtering medium, though it should be effective in arresting dust particles, should not offer such resistance as to impede respiration when worn for some hours under the actual conditions of work.

(6) It is desirable that it should be as little unsightly as possible.

It should be noted that the prize is offered for a respirator intended merely to arrest dust, and not for a chemical respirator designed to arrest poisonous fumes. The applications of such chemical respirators are more limited, and there are special requirements connected with them. The council have, therefore, preferred to limit the range of their present offer to the simpler and more important cases of dust, either dust of all kinds or of some special character, e. g., iron or steel.

Inventors intending to compete should send in specimens of their inventions not later than December 31, 1903, to the secretary of the Society of Arts, John Street, Adelphia, London, W.C. Such specimens must be accompanied by full descriptions, and in cases in which the apparatus has been put into actual use, the experience of such use should be given.

Competitors intending to patent their inventions should be careful to obtain protection, as the council of the society cannot undertake any responsibility as regards the secrecy of the whole, or of any part, of an invention submitted to them.

The prize will be awarded on the report of judges appointed by the council.

The competition is not limited to British subjects.

The council reserve to themselves the right of withholding the prize, of extending the time for sending in, or of awarding a smaller prize or smaller prizes.

SCIENCE NOTES.

Science is nothing but trained and organized common sense, differing from the latter only as a veteran may differ from a raw recruit; and its methods differ from those of common sense only so far as the guardsman's cut and thrust differ from the manner in which a savage wields his club.—Engineering Record.

Calcite, when perfectly transparent and free from flaws, has great value for optical purposes. The locality which has yielded the largest quantity of fine calcite crystals is near Eskifjördhr, Iceland, and for this reason crystals of good quality are commonly termed Iceland spar.—Engineering and Mining Journal.

The latest addition to the German language is the word "knusperchen," meaning a little thing that can be nibbled. This is the word that has just taken the prize offered by some German educational society for the best translation of the noun "cake."

Phosphorus dissolves slowly in most of its solvents. Sometimes frequent agitation for weeks is required before saturation is effected. C. Stich (Pharm. Zeit.) has determined its solubility in the following liquids, the weights given being the weights of phorphorus in 100 grammes of saturated solution: Almond oil, 1.25; oleic acid, 1.06; liquid paraffin, 1.45; water, 1.0003; acetic acid, 96 per cent, 0.105.

The general public, we fear, is not acquainted with the dangers arising from arsenic coloring matter in wall paper. A recent death in Palmer, Mass., is directly attributed, by the medical authorities, to this cause. The trouble which resulted so disastrously made its appearance a year and a half ago in what seemed to be nervous dyspepsia. Two months of travel abroad seemed to greatly improve the patient, but on returning home he soon grew worse again. On account of certain conflicting symptoms which could not be readily accounted for, a specialist was called in and gave it as his opinion that there was arsenic poisoning in the system. An investigation was then made which resulted in the discovery of arsenic colors in the wall paper of the sitting room. This room had been papered shortly previous to the appearance of the first symptoms. The wall paper was at once removed, but the disease had by this time progressed so far that it was impossible to save the life of the unfortunate victim.

Andrews (Chicago Medical Recorder) mentions the usefulness of the tuning-fork in the diagnosis of fractures, especially of the long bones. The test is made by placing the bell of a stethoscope over the bone near the supposed fracture, where the soft tissues are as thin as possible, and the handle of a tuning-fork as close to the bone as possible beyond the supposed seat of fracture. The sound will be transmitted through the shaft of the bone to the stethoscope and through the stethoscope to the ears of the examiner. When the bone is intact, if the test is properly made, the sound of the fork will be heard with great distinctness; but if there is a lack of continuity, the sound will either not be heard at all or will be heard very faintly. By comparing the intensity of the sound on the suspected side with the sound heard under similar conditions on the normal side, the question of continuity of bone can be determined. The test for fractures is based upon the fact that bone is an excellent conductor of sound waves, while the soft tissue of the body conducts sound waves very poorly. The bell of the stethoscope should fit tightly to the skin and when comparing the sound and injured sides the instruments should be placed in the same relative positions. The sound waves will be transmitted through a fracture if the two ends are crowded together; also through a joint, especially if the articular surfaces are forced together.

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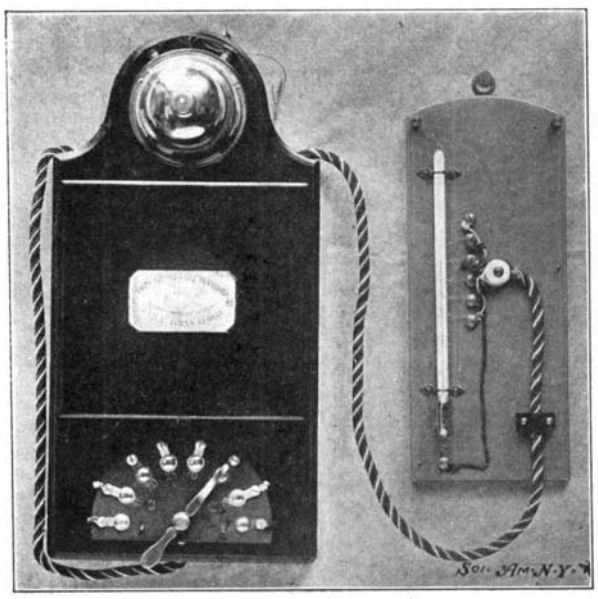
ELECTRO-TELETHERMOMETER OF JUAN VILA FORNS.

The International Congress for the consideration of all devices intended to prevent as well as to fight fires, which has just closed its sittings at London, has examined and adjudged as especially meritorious an instrument which, for want of a better name, may be called the "telethermometer," invented by Mr. Juan Vila Forns, of Gerona, in Spain.

The avowed object of this instrument is to reveal automatically at any distance from the scene of activity any abnormal elevation of the temperature which may occur in its vicinity.

The apparatus is composed essentially of a mercury thermometer connected electrically with a bell or other form of alarm, and an indicating device.

In order to establish the desired communication, it is necessary to insert into the tube of a thermometer a number of platinum wires and to arrange them five degrees apart, their uncovered ends being so disposed that, whenever the mercury rises to the figures opposite



ELECTRO-TELETHERMOMETER OF JUAN VILA FORNS.

to which they are located, the ends will form a contact with the mercury and close an electric circuit. All these insulated wires unite in a single cable after leaving the tube and are carried to and connected with an annunciator set up at any convenient place for observation. Each separate wire is connected with a metallic drop or button showing a number corresponding with the degree on the thermometer at which that individual wire is located. At the center of the annunciator, which closely resembles the half of a clock dial, is found a movable hand or switch point, which may be placed upon any one of the drops or buttons, being at the same time connected, through its fixed end, with an electric bell, also fastened upon the board, by means of a wire, one end of which is inserted into the mercury contained in the bulb of the thermometer. It is scarcely necessary to say that a battery of some kind must be included in the circuit. Now it is evident that the bell will sound the alarm every time the mercury in the thermometer tube reaches or passes the degree controlled by the wire and noted on the button under the switch point. For example, if the switch point rest upon button 115 then, just at the instant that the increase in the temperature in the room in which the thermometer is situated causes the mercury to indicate that number of degrees, contact with the wire will be established, the electric circuit closed, and the alarm given at the observing station.—E. G.

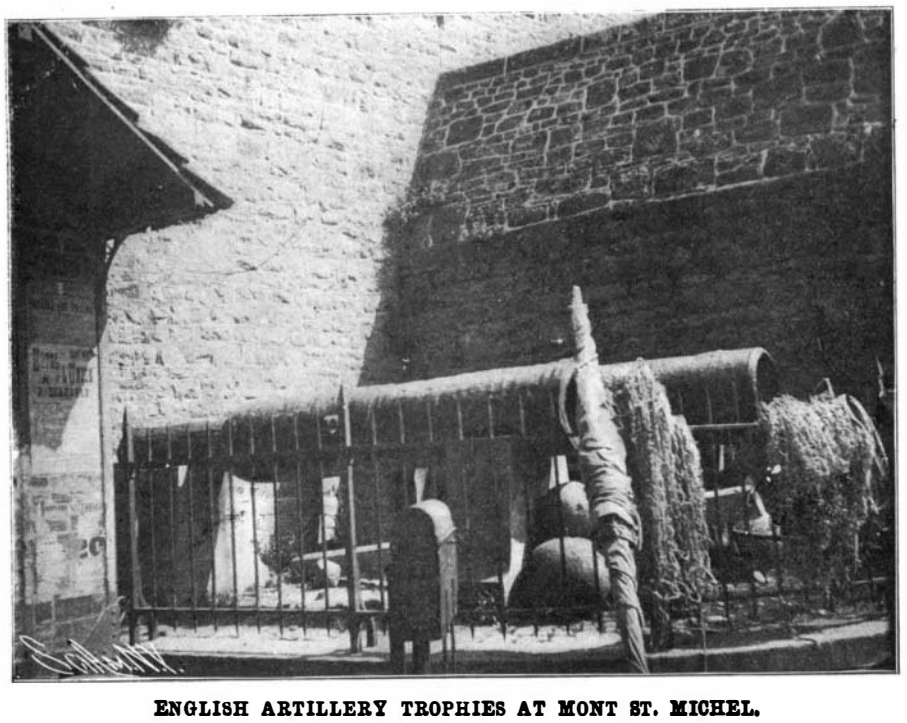
New Iron-Hardening Process.

Phosphorus, as is well known, has the property of imparting a certain degree of surface hardening to iron, but not without producing brittleness. The iron is made to assume a coarse structure, in which the crystals are comparatively loosely bound together. This effect of phosphorus of loosening the coherence of the molecules of the iron greatly facilitates the absorption of carbon by the iron. The carbon rapidly penetrates the iron to a considerable depth, imparting great toughness to the core and nullifying the comparatively slight defect constituted by the inconsiderable brittleness of the surface. Two Prussian inventors apply this principle in their process for hardening iron by heating the same in a tempering powder consisting of organic nitrogenous substances containing a high percentage of fusible ash and employing phosphorus as the medium for the introduction of carbon into the iron. Without prejudicially affecting the welding properties of the iron, it imparts such a degree of hardness thereto that it can neither be cut nor chipped by the best steel used. In order to harden the surface of about 200 kilogrammes (441 pounds) of iron to a depth of 1 millimeter (0.0394 inch) by means of this process, the pieces should be imbedded in a retort, muffle, or the like, in bone dust, to which is added a mixture of 300 grains of yellow prussiate, 250 grains of cyanide of potassium, and 400 grains of phosphorus. The receptacle is well closed, luted with clay, etc., and raised to a clear red or white heat, whereupon the material treated is immersed in a glowing condition in a water or other bath.

ENGLISH ARTILLERY TROPHIES AT MONT ST. MICHEL.

In 1427, when the English in Normandy made their last assault on Mont St. Michel under Lord Scales, they attacked it with "several powerful engines and certain machines of war," with which, says an old writer, "they trained a battery so furiously against the walls that they made a breach." Among these formidable weapons were two enormous wrought-iron guns, which they were compelled to leave behind on being obliged to raise the siege. They are still on exhibition with some of their projectiles in a railed inclosure just inside the main entrance to the town. As will be seen from the accompanying photograph taken on a recent visit, the local fishermen find this inclosure very useful for the stowage of their nets, sails, and other tackle.

The guns are of the kind formerly called "bombards," and are of different sizes. The larger one has a caliber of 19 inches, 30¼ inches greatest external diameter, and 12 feet total length, of which about 3 feet 4 inches belongs to the smaller powder chamber in the rear. It weighs very nearly 6 tons. The other gun weighs about a couple of tons less, is of 15 inches caliber and 11 feet 9 inches long. These weapons are not cast but "built-up" guns, being formed of longitudinal bars about 3 inches wide arranged like the staves of a cask and bound round closely with wrought-iron hoops, just as are the "Dulle Griete" at Ghent and "Mons Meg" at Edinburgh Castle. In fact, all four date from about the same period and the "Michelets," as they are called, as well as the others, are most likely of Flemish workmanship. Their projectiles are made of hewn granite and those for the larger gun have been estimated to weigh 300 pounds apiece. The powder chamber is capable of holding about forty pounds of explosive.



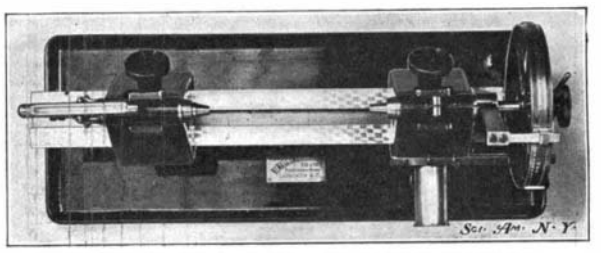
ENGLISH ARTILLERY TROPHIES AT MONT ST. MICHEL.

The Iron Age states that extraordinary results have followed the establishment of the new drainage scheme at New Orleans, by means of which the level of the ground water has been lowered 4 feet. It is now possible to construct cellars and erect skyscrapers, which could not be done previously. The drainage canals are kept clear by constant pumping. A drawback is a plague of white ants, which are devouring the woodwork of the houses.

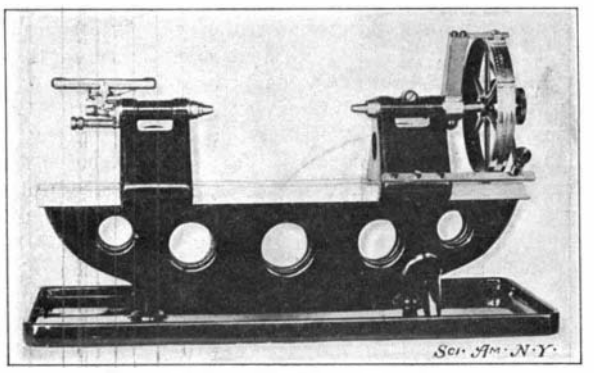
A NOVEL MEASURING MACHINE.

BY DR. A. GRADENWITZ.

Some time ago, while in London, I paid a visit to the works of the Newall Engineering Company, where I saw an interesting measuring machine just brought out by the firm. The chief novelty of the instrument is the spirit level, serving as a comparator,



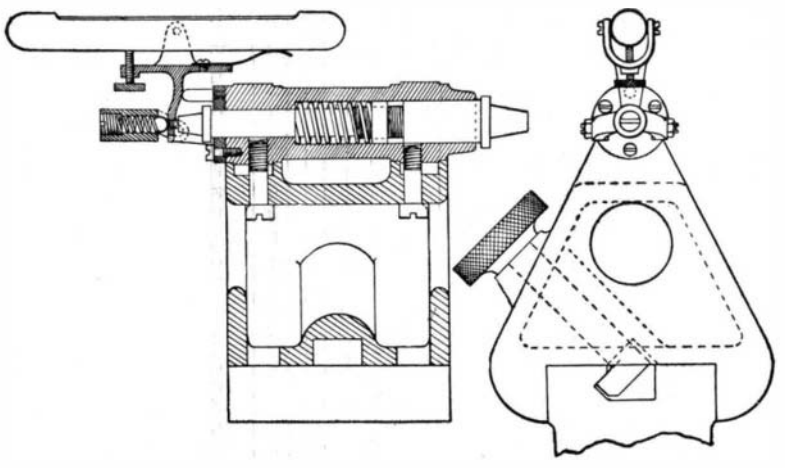
PLAN VIEW OF A NEW MEASURING MACHINE.



SIDE VIEW OF THE MEASURING MACHINE.

that is seen on the tail stock; this attachment permits of magnifying the movement of the anvil to an almost unlimited extent, as the movement of the bubble depends upon the curvature to which the vial is ground, being equal to that of a lever of the same length as the radius of curvature.

A coarse screw is operated for quick movement by means of a knurled nut, whereas for fine movement a lever is clamped to the spindle by an eccentric movement on another set of levers, a thumb screw thrusting against a bar. A vernier bar is graduated into tenths of an inch, this being the pitch of the screw, and a second vernier is carried by the rim of a graduated wheel along the first vernier bar.



TAIL STOCK ARRANGEMENT.

This graduated wheel is divided into 1-100ths on the right hand and 1-1000ths on the left, and the second vernier into 1-10,000ths. Readings can thus be taken in decimal rotation, the 1-10ths being the highest figure disclosed on the first vernier bar, the 1-100ths being the highest figure seen on the right-hand side of the graduated wheel past zero, the 1-1000ths the highest figure on the left side of the wheel past zero, whereas the 1-10,000ths are shown by the second vernier.

An anvil fits in a socket, in which is an adjustable spring controlling the amount of pressure put on the piece to be measured. The tail end of the anvil comes in contact with a rocking lever, pivoted in a bracket.

When pressure is applied to the anvil, a spirit level is displaced. The bubble on the level is first adjusted to remain at the left-hand end by means of the thumb screw. Sufficient pressure should be put on the piece being measured to bring the bubble up to a given graduation. The same course is adopted when adjusting the heads by means of end rods or with rule and microscope.

As the movement of the anvil is magnified by the level 4,000 times, if the anvil is moved one-thousandth inch, the bubble would move 4 inches. The rocking lever is kept in contact with the anvil by a spring, which may be adjusted in the boss of the bracket previously mentioned. When the pressure is removed from the anvil, the rocking lever rests against a stop. The head and tail stocks are clamped to a true flat face on the bed, as shown in the sketch.

They were designed to meet the requirements of the average tool room and are very easily handled.

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PHOTOGRAPHY IN COLORS—THE THREE-COLOR METHOD.

BY A. BOSCH.

It was nearly 100 years ago that Thomas Young, with an extraordinary foresight for one of his time, advanced the theory of the three fundamental or elementary colors, based upon scientific research, and expressed the belief that the nerve apparatus of the eye possessed three kinds of fiber, each being sensitive to a fundamental color.

Indeed three primary colors, properly chosen and combined, are sufficient to reproduce the seemingly infinite combinations of nature. According to Young, it was apparent that the colored image, which could not be produced in a single exposure, was to be obtained only by combining the three correspondingly colored images. The main difficulty, however, was the proper production of these three images.

These images are now produced by means of three colored filters or screens corresponding to the three primary colors.

For the first explanation of the elementary colors we are indebted to the Scotch physicist, James Clerk-Maxwell. He it was who first experimented with three-color photography. The experiments were, however, unsuccessful, for in 1861 we possessed no color sensitizing means.

The three elementary colors are red, green, and blue. If we place a colored object before the objective, then cover the lens with a red glass plate, acting as a ray filter, and expose, only the red light rays will be allowed to pass through the glass-plate filter and lens to affect the sensitive plate, the blue and green rays being absorbed. In this manner the red image is produced. By repeating the exposures and substituting the green and violet filters respectively, the three different negatives are obtained. From these three negatives, three positives are produced by copying upon transparent glass plates; and these transparencies are projected, superimposed, upon a screen so that they exactly register, with three corresponding light filters—colored glass plates or liquids. The result is a colored picture, astonishingly true to nature.

Maxwell's liquid light-filters for the projection of the different positives were comprised as follows: For red, a glass receptacle filled with thiocyanate of iron; for green, a solution of copper chloride; and for blue, a solution of copper in ammonia. After Maxwell came Ives, among others.

All these investigators worked along the same lines and obtained very satisfactory results, the only difficulty being that the exposure necessary to produce the three different negatives was too long. Moreover, the registering of the three positives upon the projecting screen was very unsatisfactory.

During the past year, however, much progress has been made in three-color photography by Prof. Dr. Miethe, superintendent of the photochemical department of the Royal Technical School of Berlin, and his assistant, Dr. Traube.

As is well known, the common photographic plate is sensitive to blue light rays only. If such a plate be exposed to the light by using a red filter, it would be hours and days before a negative would be obtained. The astounding success of Prof. Dr. Miethe was only made possible by his succeeding; in connection with Dr. Traube, in preparing plates which are just as sensitive to red and green light as to blue. In the past, such plates could be made only in a very unsatisfactory form. The time of exposure for red light rays was so long that a portrait was in most cases impossible.

With the new plates, however, this difficulty is overcome. The time of exposure necessary is reduced to the fraction of a second.

As a striking example of the possibility of this plate, the following illustration will serve: During the session of the Fifth International Congress for Applied Chemistry, held in Berlin in 1903, Prof. Miethe surprised the members of the photographic section by stating that he desired to take a photograph of the entire convention. It was about 5:30 P. M., with a rather threatening sky; there was much shaking of heads on the part of the members. The professor used but a few seconds in exposing the three-colored negatives. Imagine the surprise of the unbelievers when, upon entering the hall the following morning, they were shown a perfect picture of the convention in natural colors by means of the projection apparatus constructed especially for the occasion.

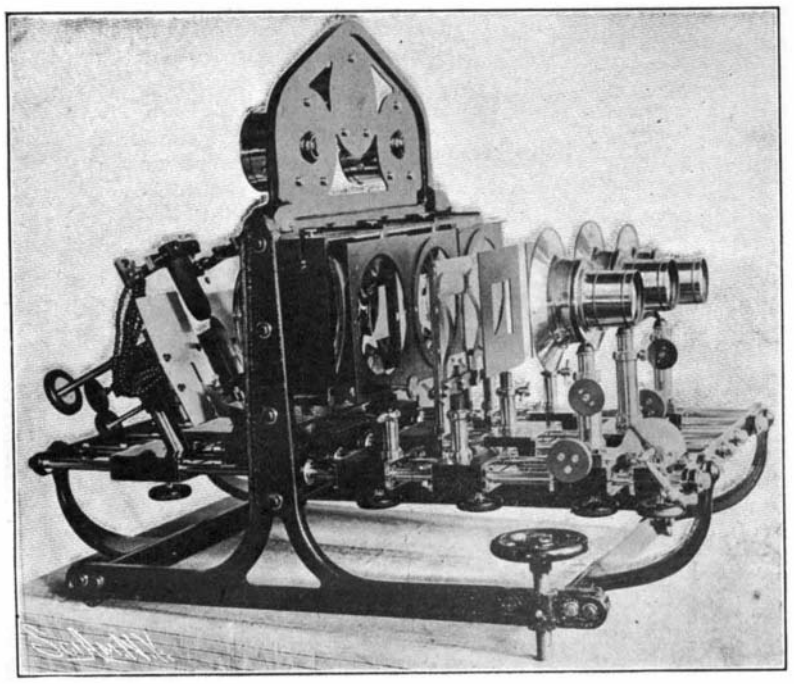

Fig. 6.—Ferd. Ernecke's Projecting Apparatus for Three-Color Slides.

Fig. 5.—The Same Scene Photographed Through a Red, a Green, and a Blue Screen.

The method of making plates sensitive to green and red rays was first published by H. W. Vogel. It consists in dipping the plates in highly diluted solutions of different dyes. After they have dried they are ready for use.

The work of Prof. Miethe and Dr. Traube has resulted in the discovery of a certain group of coloring compounds which solve the problem in a very satisfactory manner. This group was discovered in preparing a homologous series of compounds of iodide-methyl-chinoline and chinaldine derivatives. These dye compounds are colored red or violet and show a common spectrum, the absorption spectra being all remarkably alike. With the exception of amyl-cyanine, all show two absorption lines—one in the green and the other in the yellow part of the spectrum. The following table gives the positions of the absorption lines of the different compounds:

Dye.	Main Line.	Secondary Line
Amyl cyanine	597 μμ	—— μμ
Methyl-iso-cyanine	558	519
Ethyl-iso-cyanine	558	517
Propyl-iso-cynanine	563	522
Hexyl-methyl-iso-cyanine	560	519
Ethyl-methyl-iso-cyanine	558	519

These compounds are all soluble both in water and alcohol. The solubility in water decreases with increasing molecular weight. Of the above-named substances, methyl-iso-cyanine possesses the most uniform sensitizing curve in the visible spectrum, extending far toward the red. The methyl and ethyl dyes are therefore well adapted to the preparation of panchromatic dry plates, and make it possible to produce plates possessing uniform sensitivity for the entire visible spectrum, the sensitivity extending into red as far as wave length 670 μ μ, and an appreciable increasing of the sensitivity being noticeable still further into the infra-red.

Ethyl-iso-cyanine is especially adapted to photographic purposes, particularly from the fact that the sensitizing curve does not extend too far into the red, making it possible to work by a tolerably bright red light. Furthermore, it is the most easily cleansed. The preparation is as follows, according to the method given by Spalteholz: The raw product is first cleansed temporarily by recrystallizing in alcohol. These crystals are rubbed and washed with ether and again allowed to crystallize in diluted alcohol. This operation is repeated until the crystals are free from the remaining pitchy substances, which are always formed in the operation. The least traces of these impurities will cause failures and fogging in the bath, or a coloring of the emulsions by the dyes. By virtue of the extraordinary coloring power of the iso-cyanines, a very small amount suffices to bring out the desired effect.

The maximum of panchromatic sensibility is reached by using 0.016 grammes of dye per liter of emulsion, or when the finished silver bromide plate is bathed in a dye solution of 1:50000 from one to two minutes.

A further important work which had to be carried out in order to reach the desired result was the determination of the best colors for the three light filters. Briefly described Prof. Miethe's process is as follows: For the red filter the dyes of the eosine class were found to be the best—of these "Rose Bengale" being the most serviceable for the reason that, in a somewhat concentrated solution, a very broad and sharp absorption band is

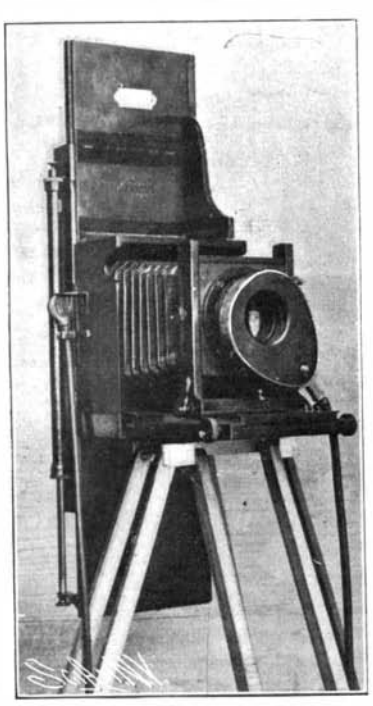

Fig. 1.—Front View of the Camera.

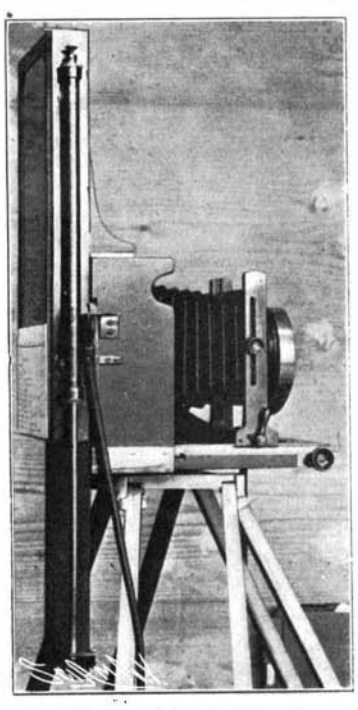

Fig. 2.—Side View of the Camera.

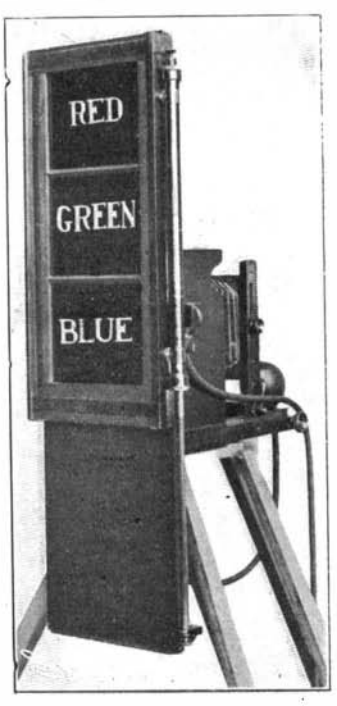

Fig. 3.—Arrangement of the Three Screens.

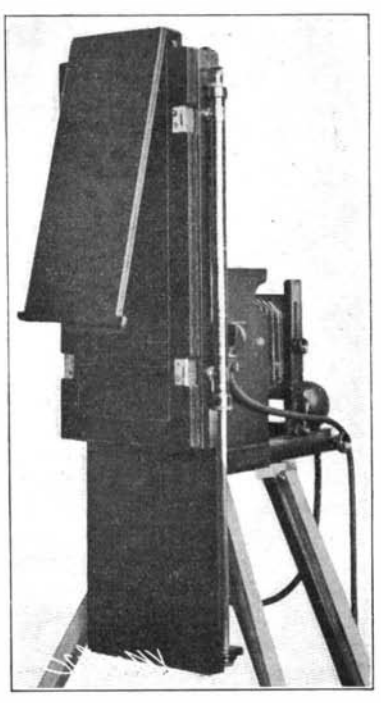

Fig. 4.—Exposing with the Blue Screen.

PHOTOGRAPHY IN COLORS—THE THREE-COLOR METHOD.

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shown in the green part of the spectrum. In preparing a red filter of the proper character with "Rose Bengales," the same must be combined with a filter which absorbs blue and blue-green. The film of "Rose Bengale" is to be so prepared that the filter, when dry should allow light waves down to wave length 590 $\mu\mu$ to pass through.

As medium amounts for the preparation of a red filter, 1.5 cubic centimeters of a 2 per cent solution of "Rose Bengale" in water to 18 to 20 cubic centimeters gelatine solution are taken, and 9 to 10 cubic centimeters of this mixture are then applied to 80 square centimeters plate surface.

If a plate, prepared in this manner, be combined with another tightly-fitting covering plate, which is colored with a yellow dye (best prepared with gelatine and a 4 per cent tartrazine solution) an extraordinarily quick-acting red filter is obtained, giving in every respect the desired position of absorption for the ethyl red plate. A great deal now depends upon the proper preparation of the green filter. An incorrectly toned filter causes as many poor results in the reproducing of colors as a bad exposure. The preparation of the green filter has consequently been very difficult. The adaptability of the green filter depends mainly upon the amount of violet rays which are allowed to pass through.

Suitable green filters can be prepared by using "brilliant acid green." Most green dyes tend to allow the extreme red rays to pass, which, however, is unimportant. Brilliant acid green, shade VI B, is best adapted for the ethyl red plate. To 6 cubic centimeters gelatine solution (for 80 square centimeters plate surface) add 1.6 cubic centimeter brilliant acid green (1:100), and to this solution 4 to 8 drops tartrazine solution (1:25).

By this means exclusion of the violet and the required retardation of blue rays is obtained.

The blue filter offers very little difficulty. It is necessary, at least in strong blue-green sensitive plates, to exclude only those rays lying in the green part of the spectrum. Light having at most a wave length of 480 should pass through. On the other hand, it is desirable that, in the reproduction of deep red tones of the original, the blue filter should allow the red of the spectrum to pass unhindered. The recipe for the violet dye is as follows: For 80 square centimeters plate surface, take 13 cubic centimeters gelatine solution, to which 2 cubic centimeters new victoria blue and 2 cubic centimeters methyl violet solution (1:250) are added.

The bright dye, however, demands too short a time of exposure. It is therefore better to retard the exposure. This is brought about by means of a very thin tartrazine disk, which is first so toned down that the blue filter permits a medium exposure. For the ethyl red plate an extra thin covering disk suffices for the equal exposure of red and blue. The required covering disk should contain 5 to 6 drops tartrazine solution (1:25) to about 120 cubic centimeters gelatine. From this short description of the colored filters, it is evident that it is possible to expose nearly the same length of time with the red and blue filters. The green filter, however, requires a much shorter period. A retardation of the green filter to about the same exposure is very difficult to bring about without seriously disturbing the curve of transmission. For the proper preparation of the color filters the following requirements are to be strictly observed:

1. A dark room free from dust.
2. Skill and painstaking care in handling.
3. A suitable cement or adhesive substance.
4. Careful observation of cement temperature and cautious warming of the plate after cementing.

Filters prepared in this way will last for a long time if not exposed directly for hours to the sunlight, which, however, is not probable in the usual method of working.

Prof. Miethe has a red filter which he has used just two years, making hundreds of exposures with it, in spite of which it has not changed in the least.

We come now to the description of the apparatus. This is made rather small in order to be easily carried. The best size for plates is 9 x 8 centimeters (Figs. 1, 2, 3).

As has been already mentioned, the exposure should be made as quickly as possible. Hence very fast lenses are required. The three images must also exactly register. A long focal distance is therefore necessary and an apochromatic lens. The choice of the latter, however, is rather limited, as apochromatic corrected lenses, i. e., those possessing a like focal distance for the main light rays, unfortunately do not transmit the light very rapidly. For a 9 x 8 centimeter plate a strong portrait anastigmatic lens, such as Prof. Miethe uses, of at least 180 millimeters focus is not adaptable. The camera differs very little from the usual form (Fig. 4), the main difference being that it is provided with a plate-holder (Fig. 4), whereby the three exposures can be made upon one plate of 9 x 24 centimeter dimension (Fig. 5), such plates being uniformly and easily developed. The three glass filters are brought immediately before the sensitive plate (Fig. 3). A ground glass just behind the color filters serves to focus the object properly.

The filters are firmly attached to, or set into the holder (Fig. 3). The plate-holder is then inserted in place of the ground glass. By means of a pneumatic release, the plate holder and filters are made to drop from top to bottom in the slide apparatus, passing successively before the lens (Figs. 3, 4, 5). The three accompanying photographs were made from a plate exposed in this manner. It is not possible to state the length of time necessary for exposure, this depending mainly upon the lens, the diaphragm, and the light. It is advisable to stop down as much as possible in order to facilitate registration.

As the ethyl red plate is very sensitive to red, the time of exposure for red and blue, behind properly chosen filters, can be taken from 1:1 to 1:4. The exposure for green is much less. Another point to be emphasized is that in preparing ethyl red plates, they should be dried with the utmost dispatch.

Highly sensitive dry plates are to be carefully dusted and worked in a bath containing: ethyl red, 0.1 gramme; alcohol, 300 cubic centimeters; distilled water, 5,000 cubic centimeters; ammonia, 50 cubic centimeters.

The washing must be done in absolute darkness, the plates rinsed under the water tap for 2 to 3 minutes, and then quickly dried. If the plates are long in drying they do not work well and fog easily. If, however, they be dried within 15 minutes, brilliant results can be obtained.

Prof. Miethe dries his plates in a current of air which passes between water pipes, whereby the escaping moisture from the air is quickly condensed upon the pipes. The air being now dry is slightly heated and then passes off over the plates. The plates dry in about 12 minutes. The developing and further arranging of a 9 x 24 centimeter plate with the three negatives (each 9 x 8) is the same as that of a usual plate.

THE PROJECTION APPARATUS.

Colored projections were shown for the first time by Prof. Miethe in the Urania Theater, Berlin, in the winter of 1903. The projecting apparatus used upon this occasion was built by the well-known firm of Ferdinand Ernecke, Berlin, manufacturers of precision instruments, being assisted by the scientific manager of the Urania, Dr. Donath. The apparatus consists of 3 arc lights (hand regulated) and consumes the enormous current of 200 amperes, or 45 horse power, only 10 per cent of this being transformed into light, while the other 90 per cent passes off in the form of heat, thus making it very difficult to protect the light condensers and to keep them from cracking.

These light condensers consist of 3 lenses each, and are insulated against the heat of the carbons by means of a hard glass plate. In front of the condensers are the cooling receptacles, which also act as filters for different light rays, being filled with the three respective solutions, above described for filters.

A voltmeter is provided for each lamp whereby the current and potential in each pair of carbons is carefully regulated. The lantern slides are inserted between the condensers and their projecting lenses.

The 9 x 24 centimeter plates (positives) are cut into three parts; the red, green, and blue positive being then glued on to another larger plate at equal distances from each other and corresponding to the distance between lenses.

This method permits quicker handling of the apparatus, making a focusing of the lenses for each picture unnecessary. The lenses were made by the firm of Voigtländer & Son, Braunwick, being triple-anastigmatic and exactly alike in focus, transmission of light, etc., and, of course, very expensive. Owing to the small number of lenses, very little light is lost through reflection or absorption.

The apparatus is as near perfect as the skill of the mechanic will permit. It can also be used with lamps of less current consumption (15 to 20 amperes) by substituting smaller carbons.

Longitude Difference Between Greenwich and Paris.

The investigations concerning the longitude difference between Greenwich and Paris have now been completed. The work has been of a particularly arduous and protracted nature, necessitating enormous calculations. Altogether the English and French observers have carried out 230 observations, equivalent to eighty nights' work each. Two English and two French observers have been engaged upon the task. The observations were made at Greenwich and Paris simultaneously, and in order to obtain absolutely similar results the instruments were frequently interchanged. The results of these observations have proved both the Greenwich and Paris existent meridians to be erroneous, the calculations finally working out just between the two. The discrepancy, however, is very minute, being only a small fraction of a second.

SPIER FALLS DAM AND POWER PLANT.

BY WALTER H. MAIN.

The imposing power plant which is now nearing completion at Spier Falls, which is located about ten miles above Glens Falls, in this State, has scarcely attracted the attention which its magnitude demands; for when the complete plant, as now laid out, has been installed, the ten great turbines will have an aggregate capacity of 50,000 horse power, which is equal to that of the famous electric plant as originally installed at Niagara Falls. The site of the dam was selected because of the natural advantage conferred by a fall of the Hudson River, which is well adapted at this spot to the creation of a great reservoir. The river flows between the Luzerne Mountains on the north, and Mount McGregor on the south, and the two form a valley which at this point is about half a mile in width. The underlying rock is of good quality, well adapted as a foundation for masonry, and the watershed of the Hudson above the reservoir contains about 25,000 square miles.

The dam, of which we present several illustrations, has a total length of 1,800 feet and contains 181,000 cubic yards of masonry. It is built of a fine quality of granite which was obtained from the Saratoga hills. At its deepest point it measures 156 feet from bedrock to crest, and a cross-section at this point shows a total width of base of 115 feet. The structure is virtually composed of three parts. Its northerly section, which abuts on the Warren County shore, is 820 feet in length and rises to an elevation of 80 feet. This is separated by a wing wall 10 feet in thickness from the southerly portion, which extends for 550 feet and is 90 feet in height. South of this is the canal, 420 feet in length, by which the water is led from the reservoir to the fore-bay at the back of the power house. At the fore-bay it is led by ten steel tubes, each 12 feet in diameter, to as many 54-inch turbines, which will be run under a 90-foot head. Each turbine will be direct-connected to a generator of 5,000-horse-power capacity. The ten units will be located in a handsome power house, 400 feet in length, which will be built of brick and steel, and will conform in every respect to the best modern construction and finish for large hydraulic-electric power plants. In order to secure the greatest possible head of water, the power house is located in what was formerly the bed of the river. The total cost of the plant is about $2,000,000.

The marketing of the power (a problem which in some of the larger power plants that have been constructed of late years has proved to be more serious than was anticipated) has presented no difficulties, because of the large number of important towns and manufacturing centers that are within easy reach. Within a radius of 50 miles are Glens Falls, with its shirt factories and other industries; Saratoga, with its big demand for electric lighting; Troy, which produces more collars, cuffs, and shirts than any other city in the world; Schenectady, with its great electrical and locomotive works; Watervliet, with the United States arsenal and gun factory, and Albany, the capital of the State. Throughout this section there are many hundreds of miles of interurban trolley lines, which find cheaper power in the dammed-up energy of the Hudson River, than in their own coal-fed power plants. So promising is the demand, that thirty years' contracts have been made for practically the entire output of the plant.

The provision for transmitting the power was a large undertaking in itself. A right of way for pole lines was secured, the three-phase system was installed, and mounted linemen, in relays of fifteen miles patrol every foot of the line each day. All the linemen are kept in communication with the switchboard by a private telephone line, and the loss of power due to defects of transmission is practically nothing. The power is distributed as alternating current of high voltage to sub-stations in the various cities and towns, where it is transformed and stepped-down to the particular voltage required by the consumer.

Berliner's Airship.

Emile Berliner, well known for his microphone-telephone transmitter, the gramophone, and other inventions, announces that he has devised an aeroplane. From the newspaper accounts thus far published, it seems that his contrivance is made of aluminium and tin-plate, with ribs of oak and metal tubing. The whole machine is 10 feet wide by 14 feet long.

The escalator at the 23d Street station of the Sixth Avenue elevated railroad, New York city, which has been shut down recently, has now resumed regular operation. Some time ago the motor driving the escalator was connected to take current from the third rail. It was found, however, that the voltage fluctuates over a considerably wider range than had been anticipated and the shut-down was necessary in order that alterations might be made in the motor to secure better speed regulation. During the interval that the electrical changes were in progress, the receipts of the station showed a marked falling off.

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Engineering Notes.

There have been launched in the United Kingdom during the past six months 290 vessels, totaling 565,343 tons gross, as compared with 289 vessels, of 668,533 tons gross, in the first half of last year.

It was recently announced that a train from London to Plymouth on the Great Western Railway had made a run of 246 miles in 233¾ minutes, thus establishing a world's record for a long-distance run. The officials of the Lake Shore & Michigan Southern have promptly given out figures which disprove this claim. On May 21, 1903, the Twentieth Century Limited left Cleveland at 4.02 A. M., and arrived at Elkhart, Ind., at 7.23 A. M., making 246.12 miles in 221 minutes.

From the returns compiled by Lloyd's Register of Shipping, it appears that, excluding warships, there were 426 vessels of 1,028,099 tons gross under construction in the United Kingdom at the close of the quarter ended June 30, 1903. The return shows an increase in the tonnage under construction of about 54,000 tons as compared with the figures for last quarter, but a decrease of about 385,000 tons as compared with the total reached in September, 1901, which is the highest on record.

The new dock which is being built at Boulogne, and which will be called the Bassin Loubet, is to be a deep tidal dock, without gates, and rectangular in form; the north and south quays will each be 350 yards in length, the west side 219 yards, and the east 165 yards. Alongside the north quay there will be a depth of 13 feet at low spring tides; at the south quay there is to be a depth of 25 feet at lowest spring tide to enable ocean liners to lie alongside it at low water. The dock, which will cover an area of 16 acres, will be entered from the east end. The Bassin Loubet is to occupy the site of the Capécure sands and sand battery. The latter has been entirely removed and set up on a new breakwater.

Writers in the English press appear to have been much exercised over certain statements made by a Woolwich gunsmith in support of his claim for compensation against a railway company who seek to acquire his premises for the improvement of their line. The gunsmith, who occupies quite ordinary premises adjoining the railway station, asked the modest sum of £2,684 for being turned out against his will, and in explanation of his demand said that his profits ranged from 200 to 800 per cent, one specialty of his, described as a wind-gage, which cost 9s. to make, selling for £2 14s. On gunpowder he made an average profit of 200 per cent. These figures are enough to make the mouth water, but they are questionable.

A paper was read before the Association of German Engineers, by Prof. Schmoller, of Berlin University, entitled "The Borderland between Technical Progress and Practical Economics." He said that "In the year 1750, when Germany had a population of 18,000,000, of whom 9,000,000 were laborers, the proportion of the physical power exerted by the human factor in economic activity was to the power exerted by machinery in the ratio of one to one. In the year 1895, when Germany had a population of 56,000,000, of whom 28,000,000 belonged to the laboring classes, the proportion of manual labor to labor done by machinery was as one to six, or, according to other estimates, as one to ten. Nevertheless, it was recognized that the machine without the superintendence of the human factor was merely an automaton, and that its productivity could only be immeasurably increased in cases where industrial processes could be resolved into a variety of constantly recurring and identical movements."

The British Admiralty has experienced considerable difficulty in the storage of the steam coal for the war vessels at the coaling bases, since the fuel is injuriously affected by wind and water both in volume and calorific power when stored in bulk. To overcome these disadvantages, which are more serious than may be supposed, an ingenious floating coal depot is being constructed for the Admiralty. In design it resembles an enormous tank capable of holding 12,000 tons. It comprises a waterproof steel framework, very similar in design to the hull of a cubical battleship, and into this is sunk a central shaft, which lets down into an open area corresponding in dimensions with the base of the depot. Pumps are provided to remove any water that may leak into this chamber, while periodically the men descend the shaft to release the coal outside as it settles downward. The vessels containing the coal are moored alongside the tank, and the fuel is removed from their holds by means of four traveling cranes which shoot it through hatchways—one provided to each crane—into the body of the tank. The coal gradually settles downward, and when it is desired to coal a vessel, it is drawn from the bottom of the reservoir through scoops and transferred to the bunkers of the warship. By this means it is anticipated that it will be possible to keep the coal as fresh for months as if it had only been drawn from the mines as required.

Electrical Notes.

Statistics prepared by the United States Census Bureau show that upward of 502 million dollars is invested in the electric light and power undertakings of that country, which number 3,619, and that the gross yearly earnings of these amounted to upward of 85 million dollars. The total annual expenses amounted to 67.7 million dollars, of which about 20½ million dollars was paid in salaries and wages, and 22.8 million dollars for supplies and materials. The horse power of the machinery installed totaled 1,758,175, of which 381,134 were generated by 1,378 turbines, and the remainder by 5.921 steam engines. The total output for the year in kilowatt hours was 2,437,218,732 units.

The Miller signaling system has been adopted for the Severn tunnel on the Great Western Railway. The tunnel is 4 miles and 600 yards in length. With the new signaling system the tunnel will be divided into sections of 1,200 yards length, thus permitting more than one train on the same line in the tunnel at the same time and with perfect safety. The usual semaphore signals at the sides of the line will be supplemented by "repeat" signals indicated in the cab of each locomotive before the eyes of the driver. This system, which can only be used in connection with electrical track circuit signaling is in successful operation in the Park Avenue tunnel of the New York Central Railway.

It has been decided by the Prussian State Railways Administration to run all the trains on the suburban railway between Berlin and Lichterfelde by electricity. This is said to be an outcome of the long series of trials on the military railway between Berlin and Zossen, which proved the advantage of propelling trains by electric power. An experimental train has been running on the Berlin-Lichterfelde section for the past month with much success. Locomotives by this time are entirely banished from the line. The method of working is by motor cars, each train consisting of two long coaches, one second and one third class, each with separate compartments for smokers. The advent of electrical working on one of Berlin's suburban lines is regarded as the beginning of a new era in railway locomotion in that city, which will soon see steam haulage on all the suburban lines displaced by electric propulsion.

In the investigation of the conductivity of ordinary air, by H. Geitel and C. T. R. Wilson, a certain amount of uncertainty is introduced in the determination of the capacity of the electroscope. In a method proposed by F. Harms, in the Phys. Zeitschr., this uncertainty is avoided. The method consists in determining the rate of discharge from a body suspended in air, and the potential measuring apparatus is only connected with the body at the instant of measuring the potential. The charged body is a brass sphere suspended on a glass thread, it is charged to a certain potential by means of a battery, and after a certain time has elapsed, it is connected to the electrometer and its potential is measured. It is again charged to the original potential, and after a different interval of time its potential is again measured, and so on, each experiment giving one point on the curve of discharge. The experiments give the number of ions used and regenerated per second, and cubic centimeters in air at 19 deg. C. as 28, while C. T. R. Wilson's experiments gave from 14 to 19 at 15 deg.

D. Negreano, in a communication to the Paris Academy of Science, described a new process for separating metallic powders from inert matters. On an insulated metal plate the pulverized mixture is placed, the plate being connected to the negative terminal of a Wimshurst machine. On bringing up to the plate a metal disk connected to the positive terminal of the machine and projecting the pulverized substance in a vertical direction by means of a special blowing machine, the metallic powder is found to be repelled and partly deposited on the upper parts of the disk. The separation will occur readily when operating with sand and metal grains; experiments with sand grains and very small copper and bronze grains have shown nearly the whole of the metal to be deposited on the disk. This phenomenon is explained as follows: in the space between the metal plate and disk, the combination of which constitutes an air condenser, the field being uniform, the flux will be perpendicular to the disk; in the neighborhood of the edges of the disk the lines of force will undergo a bending effect, so that the lines parting from the plate beyond of the surface facing the disk will be curved in toward and made to terminate on the latter, this being the path followed by the metallic particles deposited. The above process may serve in some cases to separate a mixture of finely divided metals. When applied to a mixture of brass and copper particles, for example, experiment shows that the brass will be repelled and deposited on the metal disk. The process may, as well, be applied to separating the metallic part of an ore from the gangue.

Motor Cars as Feeders to Trunk Railroads

A service of motor cars, for feeding its trunk railroad, has been established by the Great Western Company of England between the station at Helston, in Cornwall, and the Lizard, some eleven miles distant, and to which there is no railroad communication at present. A short time ago we drew attention to the possibilities of the automobile to act as feeders to trunk railroads, especially in inaccessible places, or where the traffic is not sufficiently extensive to render any other means of communication remunerative. The cars which the Great Western railroad have selected for their service are the Milne-Daimler gasoline vehicles developing 16 horse power on the brake. There is accommodation for 32 passengers. The journey between the Lizard and Helston station, which is over a somewhat hilly road, will occupy approximately 1¼ hours. This service is purely experimental, but should it prove successful, similar services will be initiated, upon other sections of the railroad system where the townships or villages are located some distance from the railroad.

The Great Western Company are also completing arrangements for the introduction of a railroad motor car service upon the section of their track extending from Stonehouse to Chatford, through the Stroud Valley, a distance of about seven miles. The power in this instance will be steam, the motor being carried in a compartment at one end of the vehicle. The length of the car over all is to be 56 feet by 9 feet, 3¼ inches maximum width. It will be built on the bogey principle, and will weigh 34½ tons, with accommodation for 42 passengers. The seats will be placed longitudinally on either side of a central gangway. The motor compartment will be inclosed right in and will be scarcely distinguishable from the remainder of the vehicle. The funnel will protrude slightly above the roofing of the car. The power to be generated will be sufficient to supply a tractive energy up to 30 miles per hour. The motor will not be fitted with reverse motion, as it is to be controlled and driven from either end of the car. The introduction of these steam motor cars is due to the severe competition of the local street surface railroads, which, since conversion to electric traction, have conveyed the larger bulk of the passenger traffic formerly carried by the railroad trains. It is thus anticipated that by the employment of the single motor coaches for short distances, the railroad company will be able to regain the whole of its former traffic, especially as the service will be quicker, and thereby constitute a powerful rival to the street surface cars.

Death of Frederick Law Olmsted.

On August 28, Frederick Law Olmsted, the famous American landscape architect, died at Waverly, Mass. Hardly a city in the Union has not at some period made use of Mr. Olmsted's genius. It was in 1856 that Mr. Olmsted and Mr. Vaux made plans for New York Central Park. From that time on Mr. Olmsted's efforts were given almost entirely to the work of landscape gardening. With Mr. Vaux, Mr. Olmsted prepared complete designs for Prospect Park, Brooklyn, laid out public parks in Buffalo, the South Parks of Chicago, and the Chicago suburb of Riverside, as well as many other large and small parks of a similar nature in other places. In 1875 he severed his connection with Mr. Vaux and became the salaried landscape architect of New York city. In 1878, he planned Boston's system of parks, for which purpose he moved to Brookline, near Boston. Perhaps his most recent famous undertaking was the laying out of the World's Fair Grounds in Chicago, for the splendid success of which enterprise he received honorary degrees from Harvard and Yale.

The Current Supplement.

It is the purpose of the editor to publish in the SUPPLEMENT, in three installments, an article by Emile Guarini on "Mechanical Handling of Coal and Coke in France." The first installment appears in the current SUPPLEMENT, No. 1445. The system described, although not quite so absolutely mechanical as the American system, is nevertheless interesting. Airships are just now much in the public eye, for which reason an article on the development of the flying machine should be welcome. William Metcalf discusses "Springs." The Dettmar electric speed indicator for locomotives and other vehicles is described in full. Many illustrations accompany the text. Charles E. Randall presents an account of Utah's "hot-pots." Not the least interesting article in the SUPPLEMENT is Lord Kelvin's striking mathematical analysis of ether and gravitational matter through infinite space, discussing as it does the possible density of the luminiferous medium and the mechanical value of a cubic mile of sunlight. Randolph I. Geare presents some information on "Savage Tattooing," in addition to that to be found on another page.

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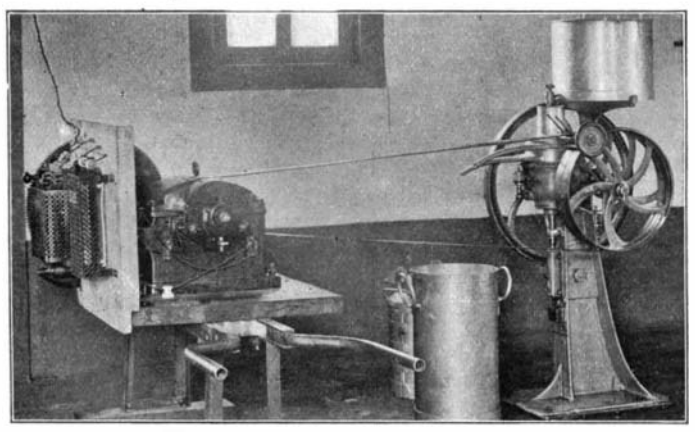
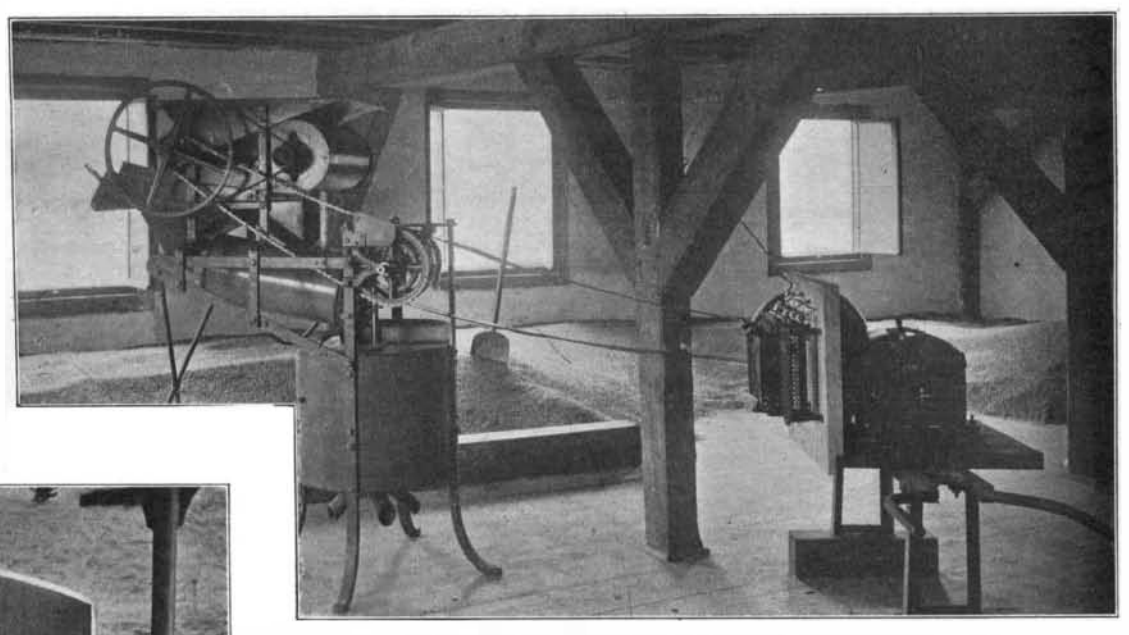
ELECTRICITY AS AN AID TO AGRICULTURE—A DESCRIPTION OF TWO MODEL ELECTRICAL FARMS.

BY EMILE GUARINI.

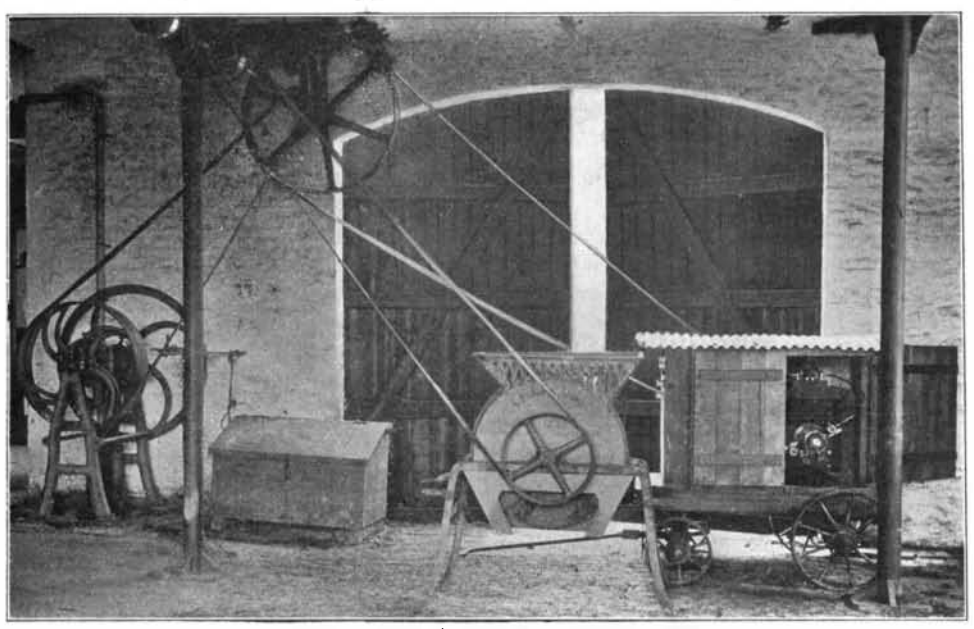
Perhaps the only use to which electricity has been applied in agriculture, with which our readers are familiar, is the electrification of seeds in order to accelerate germination. Still, other applications of electricity to the needs of the farm have been crowned with notable success. Electric plows have been found to do their work better than draft animals harnessed to the old-time share; for the soil is turned up from a greater depth. To protect the soil from insects and worms, electricity has proved itself a valuable aid. In harvesting, too, it has been found that work can be lightened and results improved by the judicious use of electrically-driven apparatus.



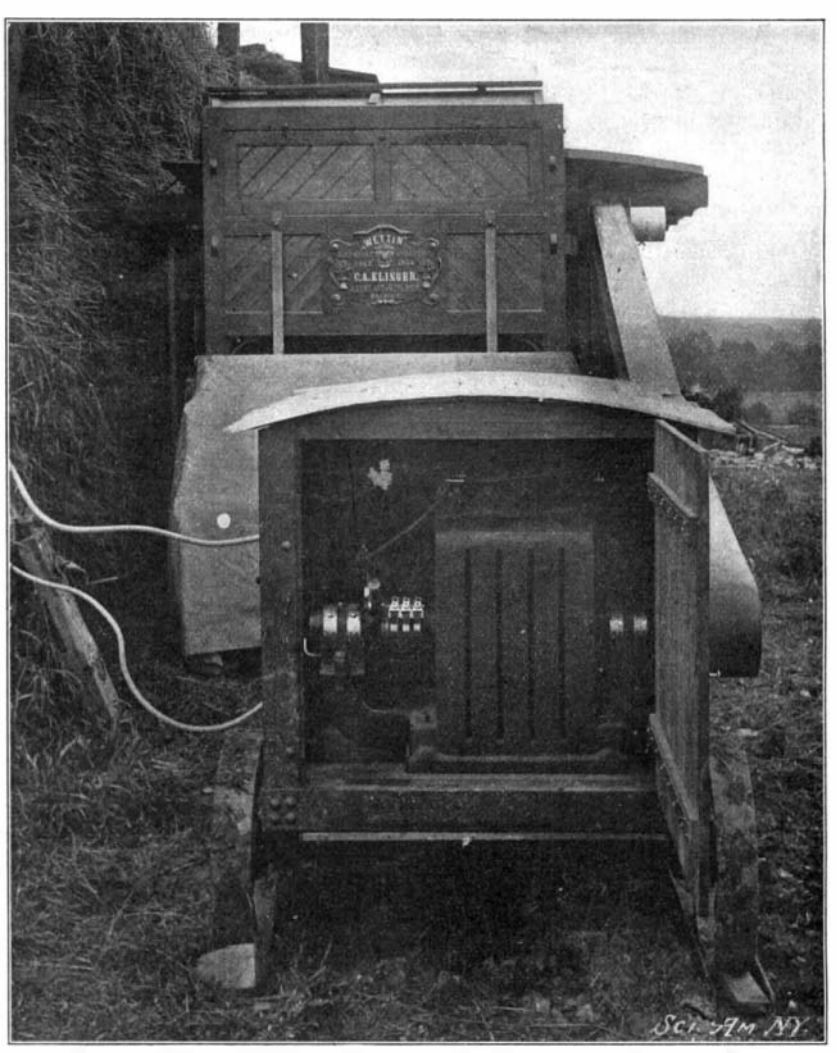
Motor Driving a Cream Separator.



Grain Cleaner Driven by Portable Motor (Simmern Farm.)



Portable Motor Driving an Overhead Shaft.



Portable Motor Driving a Threshing Machine on the Simmern Farm.

Transformer Cart.

ELECTRICAL APPARATUS FOR FARM WORK.

Threshing-machines, winnowing-machines, saws, and pumps for irrigation have been driven by electric motors with great efficiency and economy. Furthermore, by means of electricity the wine grower can age his wine, the olive grower can purify his oil, and the turf-cutter can carbonize his peat.

In carrying out all these manifold operations it is, of course, necessary to have a source of electrical power. For the purpose of showing how an electrical plant can be installed at a small cost for work in the field, three German companies, the Union, Schuckert & Co., and the Helios Company, have installed model farms on which most of the farm work is done by means of electricity.

In order to cut down expenses, central stations have been built which distribute the current for many miles at a very reasonable rate. Transformers are, of course, necessary. For electric plows, threshing machines, and for movable agricultural implements in general, the Helios Company has designed a special portable transformer, for the purpose of stepping down the high-tension current before it is sent to the motors. The same company has recently installed two model electric farms, the one at Quednau and the other at Simmern.

The Quednau farm is superintended by Prof. Backhaus of the Agricultural Institute of the University of Koenigsberg. The farm is situated near Koenigsberg, and covers about 181 hectares (447 acres). The enterprise not being very extensive, a dairy is operated in conjunction with it, the output being 10,000 liters (2,200 gallons) of milk per day. The central station comprises two divisions—the one a generating plant, the other an electric lighting plant. The power house is equipped with an engine of 50 horse power, which drives a four-pole dynamo. A current of 90 amperes at 500 volts is generated. A small two-pole dynamo is employed for electric lighting, the current generated having an intensity of 30 amperes and a pressure of 220 volts, or an intensity of 18 amperes and a pressure of 320 volts when it is used for charging a Pollak storage battery of 120 volts.

The electric lighting plant is so designed that the lamp capacity can be doubled by the utilization of a secondary dynamo. It will, however, hardly be necessary to use supplementary lamps. For cooking and for heating the living rooms electricity is also used.

Three electric motors drive the agricultural machinery. One, having a horse power of 2½, is used to drive a carrot-cutting machine. The other two are portable, and can be employed as may be desired for driving milling machinery, a machine for crushing flaxseed, a pump, a circular saw, a threshing-machine, and other purposes. On the Quednau farm an electric plow is also employed.

The Simmern farm differs from that of Quednau chiefly in the manner of generating the current. Turbine-driven dynamos are employed, the Simmern River furnishing all the water power that can be desired. The turbine used is of the Bêché type, and drives a Helios dynamo of 11 kilowatts, generating a current at a pressure of 110 volts. Since the transmission distances are not great, direct current is generated. The dynamos are also employed to charge a Hagen storage battery of 62 elements. In installing this farm it was sought to do away with manual labor as much as possible. For that reason it became necessary to design motors which should be small, light, and readily portable. The Simmern farm has two such motors. The first is of 10 horse power and has a voltage of 110, with a speed of 1,200 revolutions per minute. When mounted on wheels it usually drives four small machines, namely, a carrot-cutting machine having an output of 690 kilogrammes (1,518 pounds) an hour; a machine for crushing flaxseed having an output of 500 kilogrammes (1,100 pounds) an hour; a straw-cutting machine having a capacity of 190 kilogrammes (418 pounds) an hour, and a pump. By means of a fast and loose pulley, the four machines can be set in operation at once or can be worked independently. The same motor also drives a threshing machine, having an output of 900

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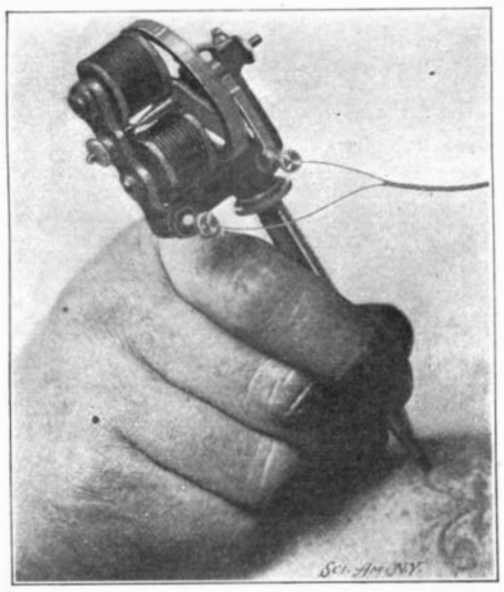
kilogrammes (1,980 pounds) an hour. The second motor is fastened to a bed-board and is portable. It has a horse power of three-quarters and drives a centrifugal cream separator having a capacity of 450 liters of milk per hour, or a mechanical winnower placed in the wheat bin.

TATTOOING.

BY RANDOLPH I. GEARE.

The custom of tattooing originated among savage people, and was primarily established, it is believed, as a substitute for writing and as a means of permanently recording facts in their lives. The word "tattoo" is derived from the Polynesian *tattaw*, and was first anglicized by Captain Cook. The practice has been defined by Berchon as "that strange and very ancient custom which consists in the introduction under the cutaneous epidermis, at different depths, of coloring matter, in order to produce some design which will be of very long duration, though it is not absolutely indelible."



The Electric Tattooing Needle.

The significations of tattooing in different regions have become so varied that collectively they may be regarded as the visible expressions of certain racial motives and impulses. Love of ornamentation, substitution for clothing, a desire to show fortitude under physical suffering, the wish to perpetuate tribal symbolism, and among women the indication of marriage, are some of them. Others, again, believed that by engraving the image of a deity on their flesh, they furnished proof of their devotion.

In some countries only the men were tattooed, while in others women alone were thus adorned. In Samoa there is a curious legend that the goddesses of tattooing swam there from Fiji, for the purpose of introducing the custom, and had been ordered to sing all the way "Tattoo the women but not the men." Having to repeat these words so often, they became confused, and when they arrived at Samoa, they were singing just the reverse; and hence arose the practice there of tattooing the men instead of the women.

There are two principal methods of tattooing, i. e., by making cuts in the flesh so as to leave a cicatrized mark, but generally without the addition of any coloring matter; and by drawing a pattern on the skin which is afterward pricked in, and to which various coloring matters are applied, so as to produce a permanent picture. Tattooing has its modern votaries among civilized people, and that it may be made a lucrative business seems proven by the fact that some years ago a device was originated by O'Reilly, of New York city, for making tattoo marks. Briefly stated, it consists of a hollow ink reservoir surrounding a suitable set of needles which are reciprocated by electric power. This implement is here shown; and that its inventor had no difficulty in obtaining customers is indicated by the examples illustrated in this connection.

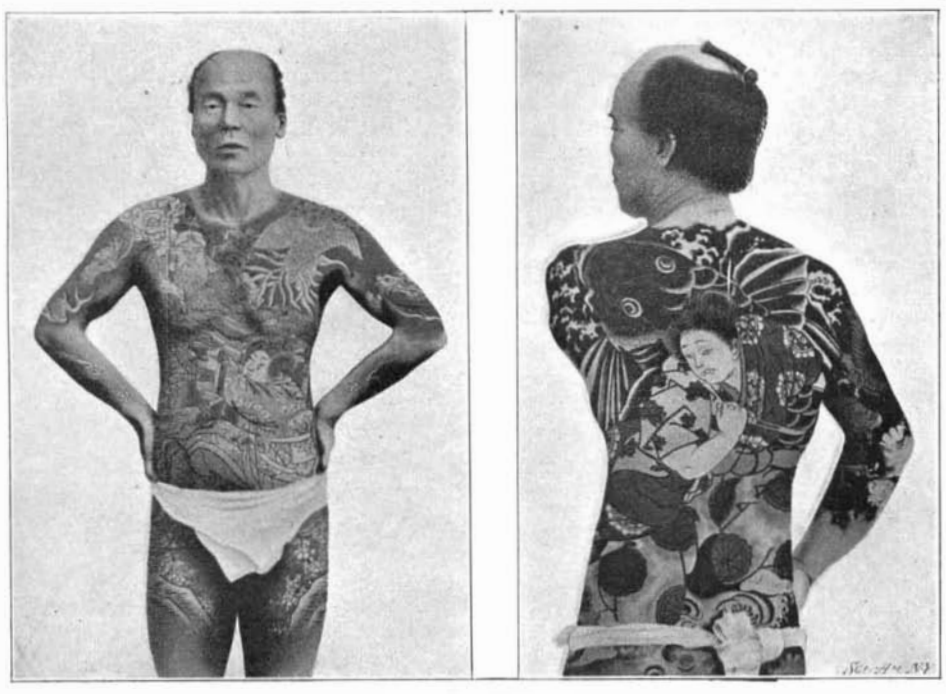
Marquesas Warrior.

For lack of space only two or three methods of tattooing can be here described. In the current SUPPLEMENT, however, will be found an account of the tattooing practices of various savage races.

Head of a Savage in Goettingen Museum, Showing Large Amount of Post-Mortem Tattooing.

Tattooed Japanese.

Tattooed Marquesas Islander.



Japanese Tattooing.

Specimen of Tattooing Done by the Electric Needle.

In all Polynesia there is no place where tattooing is so widespread or varied in character as in the Marquesas Islands. Every part of the body is decorated, from the crown of the head to the fingers and toes. This applies principally to the men, the women generally having only a bracelet or two, or other small ornaments, tattooed on their arms. One writer states that women, even princesses, have no right to tattoo any parts but their hands and feet, although at Mukahiva "noble ladies" are permitted to wear more numerous tattoo marks than the women of the lower ranks. Old men have their bald heads covered with tattoo marks.

The figures to be tattooed are chosen carefully and with appropriateness to the part to be decorated. Sometimes animals are depicted, while again other objects are employed which have special reference to the manners and customs of the people. Rows of punctures are separated by curved lines, diamonds and other designs. A man's head is completely covered, his breast is commonly ornamented with a

TATTOOING IN SAVAGE AND CIVILIZED LANDS.

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shield, while stripes of various kinds adorn the arms and thighs. On the back is generally a large cross, beginning at the neck and ending at the end of the backbone. In the front are often seen figures representing the human face. On each side of the calf of the leg is an oval figure. The hands are profusely tattooed, and each finger has its own pattern. A peculiarity of the Marquesans is that they allow the finger nails to grow very long and pointed, this being esteemed, as among some of our own people, a mark of rank, since it furnishes evidence that the person thus ornamented is not accustomed to doing hard manual work.

Among the Marquesans this elaborate ornamentation answered the purpose of dress, nor indeed would it pay the poor victim to suffer all he has to endure during the long and painful operation, only to cover all his adornment with clothes. The men wear nothing but a small cloth around their waists, while the women of rank are similarly clad, with the addition perhaps of a large piece, which they can throw over their bodies to keep off the discomfort of the sun's rays. And, curiously enough, it is not the heat they mind, but the danger of spoiling their complexions by getting sunburnt.

A noteworthy feature of the practice on these islands is the tattooing of widows' tongues, as an expression of grief for their lost husbands. In this operation the operator's implement is first dipped into the coloring matter, then placed on the tongue. It is then given a smart stroke with a rod, whereby the skin is punctured and the dye injected. A woman who was undergoing this painful treatment was asked why she allowed it. She replied that, while the pain was great, her affection was still greater, and that particular mode of expressing it was chosen because it could never be obliterated.

In Samoa tattooing is applied to the whole body from the hips to the knees, covering the skin so completely with the pattern that (as on Easter Island or in Tahiti) at a little distance the person looks as though he were wearing ornamented tights. The operation, which as in the Marquesan Islands requires much time and many "sittings," is quite ceremonious. The tattooer, called the Matai, is, as elsewhere, a man of considerable influence, and his services are engaged by a prepayment of several mats, or perhaps a canoe. Here again "combs" are used and also a little mallet, but the combs are made of human bones, about an inch or less in width, resembling little bone adzes with the edges cut with a number of teeth. These blades are attached to handles about six inches long. The pigment is made from the ashes of the cocoa-nut.

The person to be tattooed lies on his face, resting his head in the lap of his sister or some other female relative, who with other young women assisting sing loudly to drown his groans, as it would injure his record for courage to be heard giving vent to expressions of pain. Instances have occurred, however, when young braves have lost all self-control, being entirely overcome with the agony of the operation, and have been despised as cowards for the rest of their lives. The operator, having traced out his pattern, commences to drive the toothed "comb" through the skin with his mallet by sharp and rapid taps. The assistants are ready with strips of white "masi" to clean off the blood as it flows from the wounds.

In general, the patterns used throughout the Samoan islands do not vary greatly, small variations denoting the particular island on which the man lives, the family of which he is a member, the slaying of human beings, etc., the form of an animal being usually the badge of honor in such cases. It takes ordinarily an hour to cover about three inches square, after which the "patient" gives place to another. After a week or so, his turn comes round again, and as a rule an operator can only attend to five "cases" a day. When the tattooing is about half done, the operator demands another payment, and if not satisfied, he refuses to complete the work, which puts the young chief in an embarrassing position, with the alternative of going through life "half dressed" or submitting to the Matai's demands. We may conjecture that he usually "pays up." While the operation is going on, the victim suffers terrific agonies, but when it is consummated, he glories in his admission to manhood, and gains the admiration of the female contingent.

The Burmese are fond of tattooing, and use coarse needles on a long reed with a metal image of some idol on the opposite end.

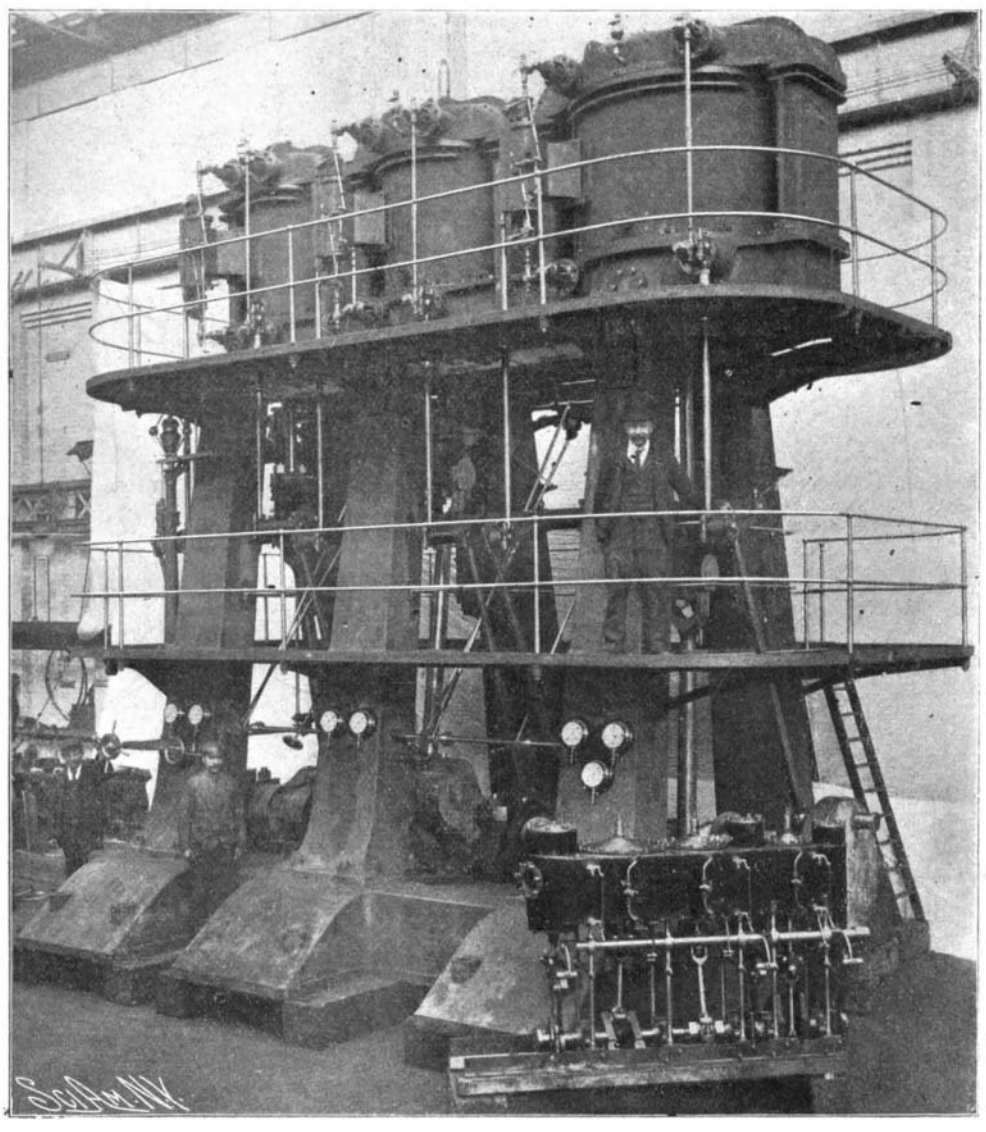
In Japan tattooing is chiefly confined to the lower classes, whose shoulders, arms, and thighs are decorated with such figures as are seen on porcelain. Cinnabar and Indian ink are the pigments used. A thief who has stolen within a specified amount of property has a circle tattooed on his arm, and on the second offense he is beheaded. They use fine cambric needles, firmly bound to a piece of bamboo about seven inches long.

A remarkable case of tattooing came to light in Prof. Hebra's lecture-room in a hospital in Vienna some thirty years ago. The man was the subject of a lecture, and one of the spectators at first mistook him for a bronze statue. He was tattooed from head to foot, and not a quarter of a square inch of his entire person was intact. The skin presented an appearance resembling the elegant tracery of an exceedingly rich cashmere shawl; only that the coloring was done with indigo principally, with enough red inserted here and there to give it effect. His name was George Constantine, a Greek by birth, who with a band of robbers entered Chinese Tartary to commit depredations. The gang was captured, and this man, with others, was ordered by the ruler to be branded in this manner. On the palms of his hands letters were tattooed, which explained that "he was the greatest rascal and thief in the world." It took three months to tattoo him, the indigo being pricked into the skin. The designs represented elephants, lions, tigers, birds, etc., with letters worked in between. A couple of dragons ornamented his forehead. He said that his body swelled up very much at the time and had ever since been sensitive to changes in the weather.

Among criminals secret hieroglyphics often form the tattoo marking, and the following specimen was observed in Portugal by Dr. Peixotto—which he believed to be some magical formula used in early Roman times to drive away fevers. It read

S A T O R
A R E P O
T E N E T
O P E R A
R O T A S

These letters read the same vertically or horizontally, forward and backward, and the reader will have the opportunity of deciphering its meaning for himself.



A TORPEDO BOAT ENGINE AND A PUMPING ENGINE, BOTH OF THE SAME HORSE POWER.

It has been decided that the telephone line between Rome and Paris is to be opened very shortly, and at all events in time for Victor Emanuel's visit to France.

Return of the Brooks Periodic Comet.

The Brooks periodic comet has just returned to visibility. This comet was discovered by Dr. William R. Brooks, professor of astronomy at Hobart College, at the Smith Observatory, Geneva, N. Y., on July 7, 1889, in the constellation Cetus. Computations soon indicated that the comet was moving in an elliptical orbit, with a period of revolution around the sun of about seven years.

True to the prediction, it returned in 1896, and now for the third time the comet makes its appearance exactly in its computed place in the heavens.

It is now in Capricornus and moving slowly westward. It is a telescopic comet and is not likely to become visible to the naked eye.

Soon after its discovery in 1889 the comet was found to be attended by four small companion comets, and hence is sometimes called the Brooks multiple comet.

In this respect it stands unique, and this, in connection with its short periodic character, renders this comet one of the most interesting in astronomical annals.

A Striking Comparison.

No more striking example of the immense power of the compact engines used in the modern torpedo boat can be offered than by the accompanying illustration. Our picture represents a large set of engines for the East London Water Company, and the engines of a second-class Yarrow torpedo boat. Both engines are of the same horse power. Unfortunately we have no data giving the steam pressure and revolutions of both installations. No doubt it would have been interesting to give a comparison of the cost of each engine, the space occupied, with the probable loss in each system for maintenance, repairs, and depreciation.

Shop Fires from Spontaneous Combustion.

Damp lampblack will ignite from the sun's rays. The same can be said of cotton waste moist with lard or other animal oil. Lampblack and a little oil or water will, under certain conditions, ignite spontaneously. Nitric acid and charcoal create spontaneous combustion. New printers' ink on paper, when in contact with a hot steam pipe, will ignite quickly. Boiled linseed oil and turpentine in equal parts on cotton waste will ignite in a few hours under a mild heat, and will in time create enough heat to ignite spontaneously. Bituminous coal should not be stored where it will come in contact with wooden partitions or columns or against warm boiler settings or steam pipes. This coal should not be very deep if it is to be kept on storage for a long period. If piled in the basement of a building it should be shallow and free from moisture, and under good ventilation. That liable to absorb moisture should be burned first. If on fire, a small quantity of water showered on this kind of coal cokes it upon the top and retards any great supply of water reaching the fire, thus necessitating the overhauling of the pile. Iron chips, filings, or turnings should not be stored in a shop in wooden boxes. The oily waste which is not infrequently thrown among them adds to the danger of fire from this source. The sweepings from the machine shop, if kept on hand, should never be placed over iron shavings. This mass of disintegrated iron is enough to incite heat and combustion. Iron and steel filings and turnings when mixed with oil will ignite spontaneously after becoming damp. A steam pipe against wood will cause the latter to ignite spontaneously after being carbonized, particularly if superheated steam enters the pipe, thus increasing the heat temperature.—J. H. L. Coon in Cassier's Magazine.

The Russian naval department has decided to increase the strength of the navy by the construction of twenty-three additional vessels of the lighter type—twenty gunboats and three torpedo-boat destroyers. The former are intended for the reinforcement of the Russian flotilla on the Amoor, while the latter are for service in the Black Sea. The whole of the gunboats are to be built at the government dock yards, will be of light draft, and will all be fitted with turbines.

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ELEPHANT ROCK AND OTHER BOWLDERS.

BY CHARLES ALMA BYERS.

A group of huge granite bowlders, of which Elephant Rock is king, at Graniteville, Iron County, Mo., located in the heart of the Ozark Mountains, has for many years furnished to geologists a subject for much study and has proved an attractive curiosity to thousands of tourists. In some respects this group might be termed a freak of nature, for freakish it undoubtedly is, and unquestionably is it of nature's designing. It is often referred to as "the granite potato patch of the Ozarks," which name is fitting, as is also the name given the giant one of the group, viz., Elephant Rock.

Elephant Rock is not only so called because of its immense size, but partly so because of its broad resemblance to an elephant. To one standing at a certain point on the north side of the bowlder, the resemblance of a portion of it to an elephant's head and trunk is easily discernible, while its color is almost exactly the same. Elephant Rock is about twenty-two feet from base to top and about thirty-five feet in length, and is of pure red granite, as are also all of the other bowlders of the group. The surface of the slight elevation on which the bowlders lie is also of solid granite, and in most places, is almost as level as a floor.

Whether these bowlders are of glacial origin has been the theme of considerable discussion by geologists. It is certain that their shape in every way indicates that they have traveled as detritus many miles in a glacial stream; but when one observes their immense size and notes the fact that they are now in the heart of a very large granite deposit, he is inclined to doubt the probability of that theory. From the latter fact it would seem that they are of local origin. And it seems evident that these bowlders could not have been deposited here during the glacial period, when the Laurentian glacier moved outward from the highland north of the St. Lawrence River in every direction, and covered North America with a continental ice sheet, for we have much evidence that this glacier did not extend below the Ohio and Missouri Rivers. North of these rivers have been found the glacial drift caused by the melting of the glacier.

Geologists of late years have generally conceded that the Ozark Mountain range in Missouri and Arkansas is the oldest land in the American continent; and were it not that this group of bowlders is found in the only granite region of the Ozark Mountains, one might believe that it had been carried here by a glacier from a more elevated part of the range; that they are the oldest remains of glaciers in the American continent. Iron Mountain and Pilot Knob are thought to have been the first elevations to rise above the waters that once covered all America, and these mountains are only four and five miles respectively from the group of bowlders, although no granite is to be found on either of them.

In connection with this, it might be of interest to state that Prof. Moorhead, instructor of archæology of the Phillips Academy of Andover, Mass., in the belief that the Ozarks are the oldest elevations on this continent, is now going over these mountains to investigate the probability that here is to be found evidence of a more primitive man than has yet been found elsewhere on this continent.

Radium and Cancer.

Dr. Alexander Graham Bell has in a letter to Dr. Sowers, a physician of Washington, made a suggestion which may lead to good results. He said in the letter: "I understand from you that the Röntgen X-rays, and the rays emitted by radium, have been found to have a marked curative effect upon external cancers, but that the effects upon deep-seated cancers have not thus far proved satisfactory. It has occurred to me that one reason for the unsatisfactory nature of these latter experiments arises from the fact that the rays have been applied externally, thus having to pass through healthy tissues of various depths in order to reach the cancerous matter. The Crookes tube from which the Röntgen rays are emitted is, of course, too bulky to be admitted into the middle of a mass of cancer, but there is no reason why a tiny fragment of radium sealed up in a fine glass tube should not be inserted into the very heart of the cancer, thus acting directly upon the diseased material. Would it not be worth while making experiments along this line?" To this letter Dr. Sowers replied: "The suggestion which you make in regard to the application of the radium rays to the substance of deep-seated cancer I regard as very valuable. If such experiments should be made I have no doubt they would prove successful in many cases where we now have failures."

"COAL-PORCELAIN."

BY L. LODIAN.

"Coal-porcelain" is probably known only in the anthracite regions of Pennsylvania. Those who live in other States of the Union, with the exception of a few relic-hunters, certainly know nothing of the beautiful utensils which are made of coal in the mining country. The exquisite natural polish to which coal-porcelain is susceptible when turned on a buff lathe, is unexcelled in black brilliancy, and exceeds in brightness the shining white surface of the finest china. Coal is a pure natural black. China, on the other hand, is rarely a pure white.

A CUP CUT FROM A BLOCK OF COAL.

The only qualities of coal that are commonly associated with it are its combustible properties. It has, however, many uses. The jet which jewelers use is nothing but coal of a very compact texture. In a Welsh country town there may be seen a foot-bridge made of coal, originally intended to be only a temporary structure, but found of sufficient strength and firmness to warrant its being used as a permanent footway. At Barcelona, Spain, there was constructed in 1888 a lighthouse of compressed coal-blocks. On a portion of the southern English coast, at a small point called Kimeridge, circular shale-disks, with a square hole (very much like Chinese "kash"), have been turned up by the plow. They are used as fuel. Curious geologists who heard of the disks, found that they were nothing but coal money; for it seems that in ancient England, in pre-Roman days, coins or tokens of coal-shale were quite common, and were perforated in order to be strung together (like Chinese "kash"), that they might be more conveniently carried.

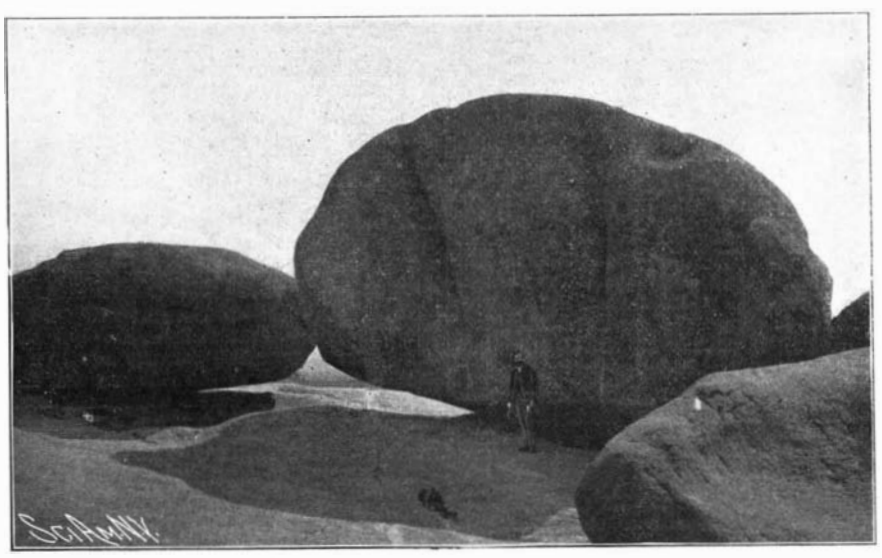
Not the least curious of these many applications of coal, is coal-porcelain. Just what can be done in the way of shaping a bit of hard coal into a useful vessel is shown by the accompanying illustration, which represents a drinking-cup or miniature bucket. Coal flower-vases, milk-mugs, plates and saucers, book-covers, clock-frames, wash-basins, inkstands, spools for lace-work, candlesticks, and scores of other articles are made in like fashion.

Since coal is a rather brittle substance, it is impossible to produce the fine ornamental work of good china-ware. There are many natural minute air-cells which may cause chipping in the making of a vessel. Still, a broken or chipped coal-utensil can be mended with cement just as readily as a bit of broken china.

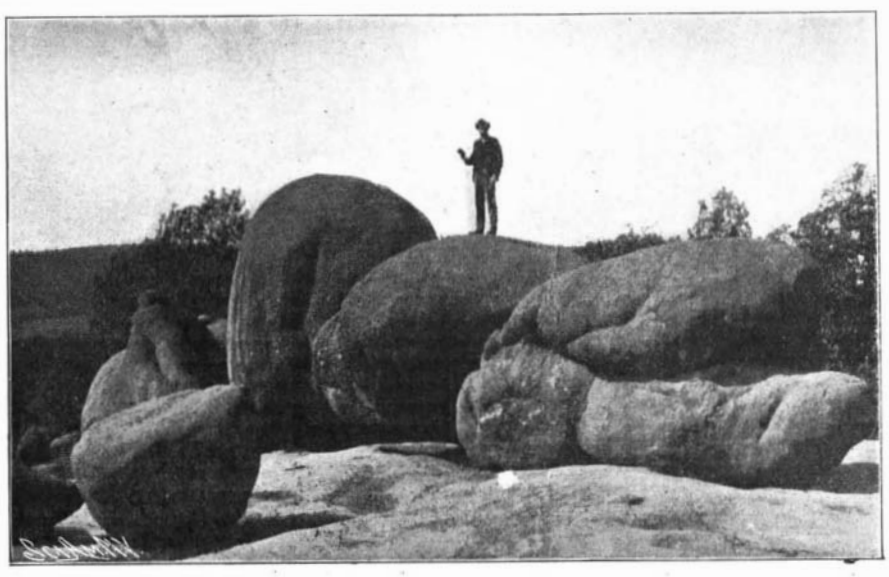
A model coal-porcelain factory is to be found at Summit Hill, Pa. Here an ex-coal miner and a few associates have for years been turning out exquisite pieces of coal ware. Although the finished coal product is cleanly enough (it can be washed in boiling soapsuds without discoloring the water), still its manufacture is one of the most uncleanly callings imaginable. As might be supposed, objects such as that here pictured are turned on lathes. These lathes are run at a very high rate of speed. The peeling off of coal-particles gives rise to small clouds of fine coal dust which settle on everything in the lathe-room. The working equipment of the coal-porcelain factory is of the simplest. Two or three chuck- and buff-lathes, and a few hand-tools of the chisel-cutting and pick order, are all that are needed. The rest is supplied by the good taste and skill of the coal craftsman.

Only the very best blocks of the hardest anthracite can be successfully used in the manufacture of coal ware. Blocks from what is known as the Mammoth vein in the Lehigh region are most prized. It requires long experience and a trained eye to determine how a piece of coal in the rough is likely to behave under the cutting lathe. The high, permanent polish which can be given to coal by the buffing-wheel serves the purpose of closing many minute pores, and renders the finished vessel impervious to hot or cold liquids.

The price of coal-porcelain averages about 50 cents a pound. The manufacturer buys the raw material for $2.50 a ton. Fashioned into utensils, the coal becomes worth about $1,000 a ton.



ELEPHANT ROCK, GRANITEVILLE, MO.



POTATO ROCK, GRANITEVILLE, MO.

Ancient Statuary in China.

Under date "Hsiaochang, via Te Chou, Tientsin, North China, April 27, 1903," Dr. Sewell S. McFarlane sends the following communication to the Royal Geographical Society: "In February, during one of my journeys in the southwest province of Chili, North China, I came across a number of stone horses, sheep, lions, etc., some in a fair state of preservation. They were in two parallel rows, and beside them were several 'petrified' Buddhist priests, supposed to be on guard. The people seemed to know nothing about them and cared less. Upon inquiry among the gentry of the adjoining village, one old gentleman informed me that it was the entrance to a very old subterranean tomb of one of China's prime ministers, who lived under the Han dynasty. This would be about the year A. D. 25. Many years ago a tablet stood there, which they unearthed with the above stone figures, giving full particulars, but the disinterested inhabitants destroyed it 'as it was in the way of their cart track.' How the people came to unearth these huge statues is interesting. During the past generations the severe dust-storms experienced in North China have swept over the district and steadily but effectually buried out of sight the beautiful tomb and all its accompaniments. The inhabitants frequently dig out their land to make mud bricks for their houses, and in this manner the stone figures came to light. It is said there are a great many more of them ere one reaches the actual tomb. Had this been in England these ancient curios would have been excavated and a correct description published centuries ago. But in China the country folk, who simply live from hand to mouth, somewhat take after Gallio, of sacred writ, and 'care for none of these things.'"

It is reported that Mr. Brodrick has sanctioned the expenditure of $10,000 on experiments with a dirigible balloon. These experiments will be carried out by the Royal Engineers, under Colonel J. L. B. Templer, the superintendent of the balloon factory.

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RECENTLY PATENTED INVENTIONS.

Apparatus for Special Purposes.

APPARATUS FOR MAKING STEEL, ETC.—E. C. WILLS, Altoona, Pa. By his invention Mr. Wills seeks to provide a rocking table or base on which the converter may be supported and to and from which the base of the converter may be adjusted in connection with means for rocking the table, so the metal in the converter may be caused to flow above or below the twyer-entrance in order that the air may be introduced above or below the surface of the metal.

Electrical Devices.

ELECTRIC FIRE-ALARM.—G. B. MARTIN, Zanesville, Ohio. In the present patent the invention has reference to electric fire-alarms, and more particularly to the production of a cheap and efficient form of fire-alarm suitable for use in houses, hotels, restaurants, etc. In case of fire the wax which holds up a weight is melted, permitting the latter to drop into a pan on the end of a lever. The lever thereupon turns on its pivots, making an electric contact which causes a bell to ring.

Engineering Improvements.

ORE-DUMPING APPARATUS.—N. A. H. SALOMONSON, Norway, Mich. In ore-dumping apparatus as usually constructed the ore hoisted from a shaft is delivered into a car, which is then run out on the trestle to a chute and pocket into which it is to be discharged. It is the object of this invention to discharge ore directly from the car into the chute and pocket intended for it without requiring that the car shall be run out on the trestle, whereby time and labor are saved in the dumping operation.

AIR AND STEAM FEEDING ATTACHMENT FOR BOILER-FURNACES.—G. MARLOW, Sr., Spokane, Wash. The invention is embodied in an improved apparatus whereby mingled air and steam are introduced into the fire-box of the boiler or other furnace to effect a more perfect combination, and especially to consume the carbon particles and such gaseous products of combustion as ordinarily escape into the air and are lost.

INTERNAL-COMBUSTION ENGINE.—C. A. WILKINSON, Worcester, Mass. The present invention relates to an internal-combustion engine in which a relatively heavy or non-volatile oil may be used for fuel, this oil being heated from the cylinder of the engine and a current of air under pressure being ejected through it, so as to carburet the air, which is then passed into the cylinder to be compressed and exploded.

ROCK-DRILL.—C. MEAD, Murray, Idaho. Mr. Mead's invention refers to improvements in rock-drills of that class which are actuated by striking the drill forcibly with a sledge in the hands of a hammersman, and an object he has in view is the provision of a compact machine which may be easily set up or adjusted to work in any desired position for the purpose of drilling a hole in the floor, wall, roof, or any other surface in a mine or other place.

Household Utilities.

FLY-TRAP.—E. F. DAVISON, Marysville, Wash. In this case the invention has reference to fly-traps adapted to door and window-screens. The improvement consists in a new and novel trap especially designed to form a part or the whole of the upper panel of a screen-door. It is also adapted to be used in connection with window-screens.

SAD-IRON.—C. W. JOHNSTON, Meeteetse, Wyo. The purpose of the improvement is to so construct the handle and the body of the iron that one can be quickly and conveniently separated from the other and the two parts as readily connected, and to provide such a locking engagement between the handle and the body that there will be no side motion of the handle at any time while the parts are in locking engagement.

HAT RACK OR HANGER.—J. G. WHITE, Meriden, Conn. The principal object of the improvement is the provision of an ordinary rack with simplified and effective devices or means whereby a hat or similar article may be held thereon without liability to accidental displacement, as frequently happens with hangers in use, and also to provide a device of this kind which is simple in the construction and the organization of the parts.

KITCHEN-CABINET.—L. HOCKMAN, Marion, Ind. The object claimed in this case is the provision of details of construction for a cabinet which render it very convenient for holding utensils and cooking material, and, furthermore, to provide doors, drawer fronts, and sides, and other parts made of laminated material to prevent warping, twisting, and undue expansion and contraction when subjected to changes in humidity and temperature.

Of Interest to Farmers.

FRUIT-PICKER.—M. AKSILA, Worcester, Mass. In carrying out this improvement the inventor has in contemplation an improved fruit-picker, which may be extended to a considerable height to enable the fruit to be removed from the highest branches of fruit trees while the operator is standing on the ground, but when the device is out of use it may be collapsed into compact form, whereby it may be stored in a very small space.

FOLDABLE FRUIT-LADDER.—S. S. WARD, Napa, Cal. This improvement relates to a class of step-ladders particularly well adapted for use in picking fruit from trees in orchards, and has for its object the provision of novel details of construction for a foldable ladder, which afford a light, strong, portable device, that has a very wide base and is therefore rendered stable in service, will not tip sidewise while occupied, and that will sustain a heavy weight without penetrating the soil deeply.

KNIFE-HEAD FOR MOWERS.—L. B. MITCHELL, Hart, Mich. This improvement provides for raising the pitman above the danger line of obstructions and away from the heavy swath of grass; furnishes a bearing easily kept oiled and all wear taken up; provides spring cushions for the knife stroke running free the intermediate space, eliminates vertical knife motion in the guards, and insures perfect shear cut of knife sections; provides for detaching the knife from the knife-head and removing the knife from the cutter bar with the bar in any position; and overcomes noises, reduces friction, and avoids breakages in pitman, knife-heads, and knife-bars.

FOUNDATION-FASTENER FOR HIVE-FRAMES.—O. O. BORDSON, Black Earth, Wis. The purpose of this invention is to provide a device adapted to secure a foundation-comb in a frame placed in a hive so that bees may build up honey-cells from the foundation and to so construct the device that it will comprise but few parts and wherein the parts may be operated to securely place the foundation-comb in the frame, and so that all parts of the device may be kept clean. This device is light, yet durable, and readily carried from place to place.

Railways and Their Accessories.

RAILWAY-SWITCH.—F. W. ALEY, El Paso, Texas. The principal object of this invention is to overcome the disadvantages and inconveniences common to many similar devices, and to provide a device of this kind which is not liable to get out of order and which is simple in the construction and organization of the parts thereof, besides possessing the capacity for long and repeated service. Reliability and safety are distinguishing factors in this railway-switch.

Miscellaneous.

ARM-REST FOR CRUTCHES. — H. S. COLE, Newtonsville, Ohio. In this case the improvement has reference more particularly to heads or arm-rests for crutches, and the principal object of the invention is the provision of a device of its kind which may be readily attached to or detached from the upper ends of the uprights or standards of a crutch and also to provide means whereby a comfortable yielding action is derived therefrom in the use of the crutch.

BAIL-EAR FOR VESSELS.—J. F. VOGT, St. Louis, Mo. The principal object of this invention is to provide a headed package, as a keg or similar vessel, with a bail and attaching-ear therefor, whereby on removal of the head thereof the keg or vessel may be converted into a bucket or similar structure, and also to provide an attaching-ear for the bails of vessels which is durable and possesses the capacity for long and continued service.

LACE-FASTENER.—J. H. O'BRIEN, Ilion, N. Y. This fastener is adapted for use in connection with shoes or boots, although the article is capable of wide application where desirable to securely hold a lacing or cord. The object in view is to produce an article or contrivance which makes provision for taking up a length of a lace or cord and operates sufficiently to secure the lace or cord against displacement or unfastening under the strain or pull thereon.

FLUE-SCRAPER.—P. F. VOGT, Dayton, Ohio. This inventor claims as the object of his improvement a flue-scraper which is simple and durable in construction, very effective in operation, not liable to easily get out of order, and arranged to readily yield for automatic adjustment in the flue and to scrape the flue both on the inward and outward movement of the scraper in the flue.

ARTIFICIAL HAND.—H. PATTON, Cripple-creek, Col. In this case the improvement has reference to a device intended to be fastened to the stump of an amputated arm by which tools of various sorts may be grasped, thus enabling the wearer to do manual labor. The device comprises a peculiarly-constructed gripper and also a novel device for enabling the jaws to be opened with one hand.

NECK-YOKE COUNTER-STOP FOR ARTILLERY-CARRIAGES.—F. WENKE, San Antonio, Texas. This counter-stop and its accompanying parts are inserted within a ferrule, and a plug and its cap are then secured in position. In placing the neck-yoke ring over the end of the pole, the counter-stop is pushed inward against the tension of a double-acting spring and the ring is slipped up against a neck-yoke stop. The counter-stop is then released and is pressed back by the spring into its protruding position, and the ring, held between a downwardly-depending tongue and the stop, is prevented from slipping forward over the end of the pole.

DESIGN FOR A BELT-BUCKLE.—L. L. PRAHAR, New York, N. Y. This design comprises two overlapping pointed ellipses in the center of which is placed a narrow clasp-shield, the whole presenting a neat, graceful, and ornamental buckle. Mr. Prahar has also secured a design of another belt-buckle comprising two tilted overlapping pointed ellipses, extending from the sides of which are the ends of two other ellipses. In the center of these is a narrow clasp-shield. The buckle is very neat and ornamental.

BOTTLE-STOPPER.—E. A. NUGENT, Unionville, N. Y. This stopper is for milk-bottles designed to be filled with milk through the operation of a milking-machine, such as shown by Mr. Nugent in a former application for patent, the object of the improvement being to provide means for sealing the bottles from which air is exhausted before removing the bottles from the machine, thus preventing the entrance of impurities from the air in the stable and preserving the milk a greater length of time.

POWDER-PUFF.—J. F. ROWLAND and G. D. HULL, Asheville, N. C. The intention of this improvement is to furnish a puff especially designed to contain talcum powder, and to so construct the puff that the material may be placed in large quantities in the puff and held distributed and in such manner that the puff may be manipulated to cover large or small surfaces, and so that all the working surfaces of the article may be utilized at all times and adapted to all parts of the human form.

LIFE-BOAT.—A. LASSERRE, Buenos Aires, Argentina. The present invention relates to improvements in life-boats; and the objects Mr. Lasserre has in view are the provision of a simple and strong construction of boat which cannot be submerged in heavy weather at sea, is not liable to capsize or overturn from the force of wind and waves, and is capable of discharging any water that may be shipped during a storm.

WORSTED-BOX.—GRACE M. WOOSTER, New York, N. Y. An object in this case is the provision of a device in which a toy is placed and hidden from view, but which may be disclosed by dismembering the box after the end of the worsted shall have been reached, thus affording amusement to a child having possession of the box and inducing diligence in crocheting to reach the end and reveal the hidden toy or wonder.

FOLDING CASE.—J. J. O'BRIEN, San José, Cal. The purpose of this invention is to provide a case which may be conveniently folded into a compact form without in any way detracting from the durability and neatness of appearance of the article and without materially increasing the cost thereof. The improvement is especially designed for application to telescopic valises, although it may be used in other connections.

PORT-LIGHT.—C. F. PETERSEN, Wilmington, Del. This invention refers to an improved construction for closing the port-lights in the sides of marine vessels, and it embodies in its general form a glass and a glass-frame connected to the body of the device by a gimbal-ring and which is hinged to the body and provided at its free side with a releasable clamp for holding it in place, and an opaque or metallic cover, which parts may be used concurrently with or independent of the glass, and by means of which the light may be hermetically closed.

REAR-VIEW HAT-MIRROR.—L. D. MERRICK, New York, N. Y. The purpose in this case is to provide a small mirror and frame and means for attaching the frame to a hat or cap and for adjusting the mirror in its frame, the attachment to be made to the under face of the brim of a hat or to the visor of a cap at one side of its front center, whereby the wearer without turning his head may see the reflection of any objects in the road, street, room, or space behind him.

FOLDING BOX.—M. HIRSCH, New York, N. Y. This box is bent from a one-piece blank of peculiar form, which not only secures a desirable interlocking of the side and end flaps, but also provides a double bottom and double sides, having the plies or layers interlocked to overcome the possibility of displacement, whereby the stability of the box is increased without appreciable cost in the manufacture and without an increase in the time and labor to bend or fold the blank to the condition required to complete the box.

BENZIN-PAN.—C. E. HOWARD and J. C. M. UNGEHEUER, Jersey City, N. J. The purpose of these inventors is to provide a pan adapted to contain benzin or like material and to so construct the receptacle that it will be provided with a cover having a tight but yielding connection with the upper marginal portion of the pan, so as to prevent ignited material being accidentally brought into contact with the contents and to so mount the cover that it may be pressed down by means of a brush to enable the brush to take up material for effective application to the face of type to wash same, for example.

DOOR OPENER AND HOLDER.—J. D. GENDRON, Gentilly, Minn. In this patent the inventor has for his object the provision of means for the opening of a door, and more particularly for the raising of a horizontal trap-door into a vertical position after it has been manually released by a slight upward pull, a further object being to adapt the improved door-opener for the retention of the door either in open or in closed adjustment, until it is started upward by slight manual effort.

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NEW BOOKS, ETC.

MECHANICAL REFRIGERATION. By Hal Williams. London: Whittaker & Co. New York: The Macmillan Company. 1903. 16mo. Pp. 406, plates. Price, $2.25.

This is a practical introduction to the study of cold storage, ice-making and other purposes to which refrigeration is being applied. It impresses the reader as being a thoroughly practical book, dealing in a lucid manner with the various problems which are constantly confronting the refrigerating engineer. It is only in recent years that ice has been used to any extent in England for table purposes. A demand, however, has sprung up in that country for hygienic ice, therefore the present book is very timely. It will be valuable to American readers as well.

SMITH'S SCRAP BOOK OF THE BIBLE. By William Preston Smith. Providence. 1903. 16mo. Pp. 551.

Quotations from the Bible arranged in alphabetical order, the same as a dictionary or concordance. It will prove very useful, especially to ministers.

CARNIVAL NUMBER OF THE TIMES. Hamilton, Canada.

We have received the special Carnival number of this enterprising Canadian journal of August 15, and note that it is filled with excellent illustrations, beautifully printed, of Canada's industrial center, the city of Hamilton, together with numerous portraits of the people prominent in building up the city.

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HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time shoul dbe repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(9171) G. G. P. W. asks: Will you please answer the following question. Whether it ever blows so hard that a sea cannot rise. A. If a wind of a certain velocity will raise a sea of a certain height, a wind of a higher velocity will raise the sea higher. There is no velocity at which the effect of the wind would reverse itself and prevent the sea from rising. Such an idea is absurd. If the sea is running high and a wind arises which blows against the sea, it will soon beat it down, but will raise a sea in the direction of the wind very scon afterward.

(9172) E. A. E. says: In an explosive engine of the gasoline type, what would you consider essential to reach perfection? Cut-off where? When to explode? How soon after exploding should exhaust open? Why not use a double-ended cylinder, assuming such to be possible? When hydrogen gas is exploded, what is the name of the resulting gas? What is its relative gravity compared with hydrogen? What caloric energy does it possess? A. In reply to your question, we would say that, in an explosive engine of the gasoline type, the explosion should occur at the end of the compression, just as the piston is starting on its forward stroke. If the mixture of the gases is weak, so that an appreciable amount of time is necessary for the combustion to be completed, ignition should take place just a trifle before the engine reaches the dead point. If the exhaust valve is of sufficient size and the valve motion properly designed so that the burnt gases can be rapidly expelled from the cylinder, the exhaust valve should not open until just a trifle before the engine is on the forward dead point. It should open in time to allow the gases to escape sufficiently to bring the pressure almost to the atmospheric pressure before the piston starts on its return stroke. By cut-off we assume you mean the closing of the admission gases. This should not take place until the end of the stroke with the ordinary type of gasoline engine, because it is desirable to have a cylinderful of air and gasoline before the compression begins. A double-ended cylinder is not desirable in a gasoline engine of the ordinary type, because it very much increases the difficulty of keeping the engine cylinder cool and properly lubricated. It also complicates the valve mechanism. When hydrogen gas is burned or exploded in air, it forms H_2O, which is the chemical symbol for water. The temperature at the time the water is formed is always so high as to cause it to exist as steam. After this steam is sufficiently cool, however, it condenses into water. When one pound of hydrogen is burned, it produces 62,000 British thermal units. The resulting gas (steam) is nine times as heavy as hydrogen under the same pressure and temperature so long as the temperature is high enough to keep it in the state of a gas.

(9173) G. N. asks: Would it be possible to use a spark coil in wireless telegraphy? Can two powerful dry batteries be used for wireless telegraphy a distance of 50 feet provided a sensitive receiver is used? A. For wireless telegraphy an induction coil is required which has a primary and a secondary winding. These are properly called spark coils, but often a coil with only one winding is also called a spark coil. These will not transmit in good shape. With a sensitive receiver a coil giving a half-inch spark will transmit to a distance of 50 to 100 feet.

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A

5 Acres, (48 Lots) Cost $12.500.00

47 Lots sold for 22 992.50
1 Lot on hand worth 475.00
Profit $ 23.467.50
10.967.50

B

20 Acres, (192 Lots) Cost $ 40.000.00

176 Lots sold for 83.210.75
16 " on hand worth 7.275.00
90.485.75
Profit $ 50.485.75

C

5 Acres, (48 Lots) Cost $ 6.389.16

39 Lots sold for 25.439.50
9 " on hand worth 5.500.00
30.939.50
Profit $ 24.550.34

I certify that the foregoing Statements are a true and accurate showing of profits, based on the purchase and selling price of the several acre tracts handled by the Campbell Investment Company, lettered from "A to C," ascertained from the books and papers of the Company.

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Expert Accountant.

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Upon application we will furnish fullest particulars.

The certificate herewith from Frederic S. Wheaton, a chartered accountant, covers the first three syndicates. They were floated during the hard times some years ago, and were less profitable than the average, showing a net profit of a little less than 150 per cent. Schedules of the other syndicates will be printed in this paper from time to time or may be had for the asking.

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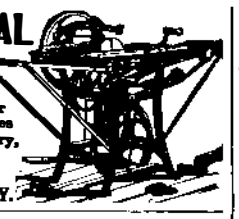

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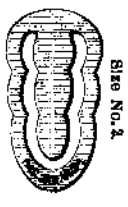

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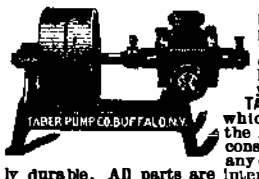

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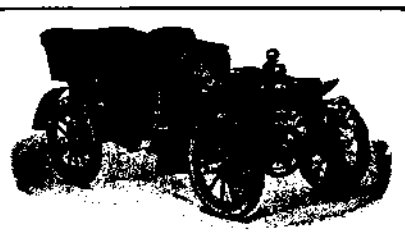

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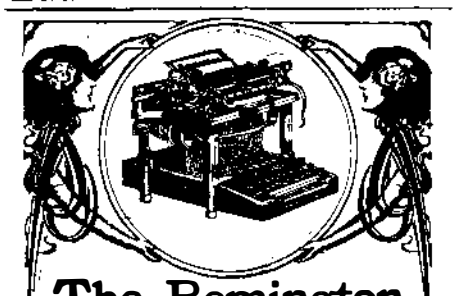

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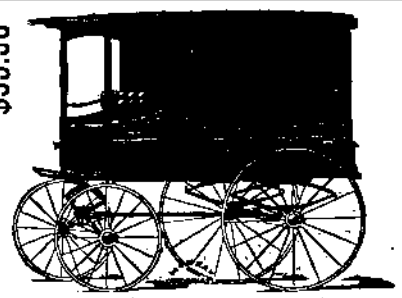

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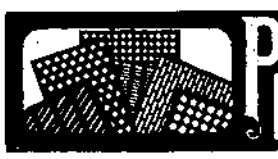

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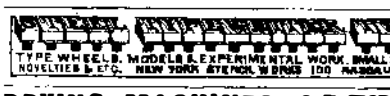

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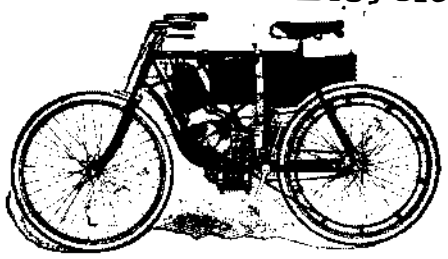

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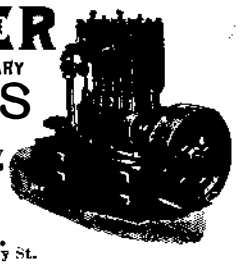

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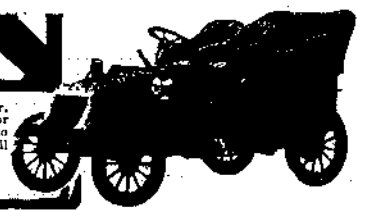

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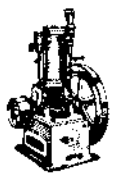

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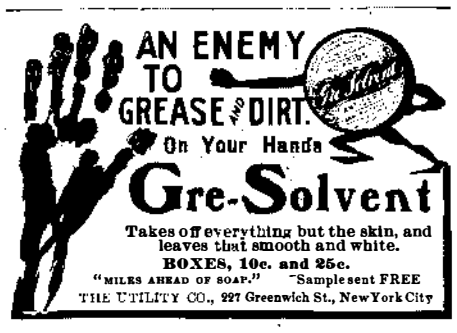

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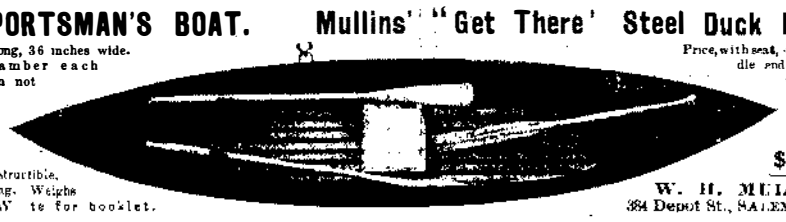

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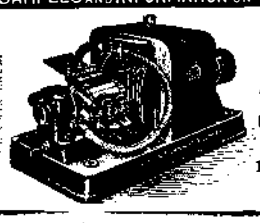

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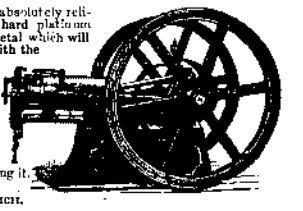

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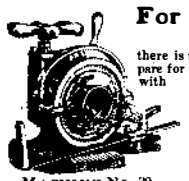

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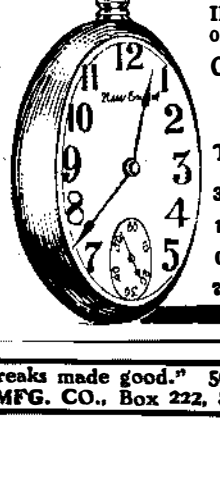

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